

PROJECT MANUAL

FOR



DT1 #1745B CATH LAB REPLACE X-RAY EQUIPMENT

OWNER'S PROJECT NUMBER: 9557230

**UC DAVIS HEALTH
2315 STOCKTON BLVD
SACRAMENTO, CA, 95817**

DATE: DECEMBER 16, 2022

FEBRUARY 24, 2023

1

PREPARED BY:

TAYLOR DESIGN

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SECTION 00 01 07
SEALS PAGE

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02/24/2023
DATE



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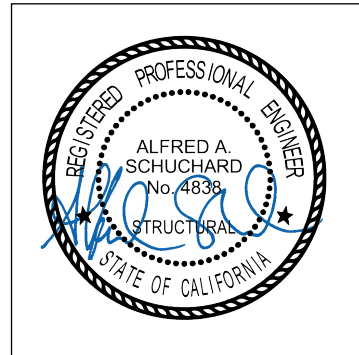
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DATE



MECHANICAL ENGINEER

STEVEN S. CROSBY

R&A ENGINEERING CONSULTANTS

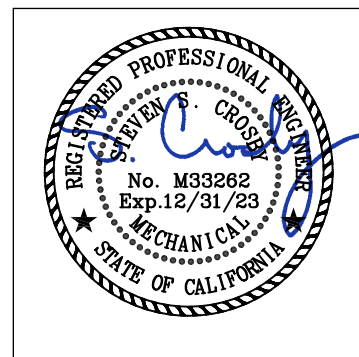
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SACRAMENTO, CA 92825



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2/24/2023
DATE



UC DAVIS MEDICAL CENTER
DT1 #1745B CATH LAB REPLACE X-RAY EQUIPMENT
PROJECT NO. 9557230

ELECTRICAL ENGINEER

ANDREW J. BELL

THE ENGINEERING ENTERPRISE

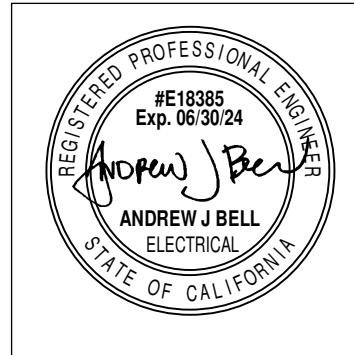
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2/24/2023

DATE



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END OF SECTION

SECTION 01 11 00

SUMMARY OF THE WORK

PART I - GENERAL

1.01 SECTION INCLUDES

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

1.02 DESCRIPTION OF THE WORK

- A. Project is titled: DT1 #1745B CATH LAB Replace Xray Equipment
- B. University Project No.: 9557230
- C. Project is located at 2315 X Street, Sacramento, CA 95817, UC Davis Health, Sacramento, California, as shown on the vicinity map.
- D. Project is a partial remodel of approximately 2,671SF within the existing Cardiac Cath Lab Department located on the first floor within the Davis Tower 1 Building 12 of the UC Davis Medical Center campus. The project scope included end-of-life equipment replacement, equipment room relocation and upgrades to Cath Lab #2 (Room 1745B), Control Room, Scrub Sink, Adjacent Corridor, Lead Vest Storage, Clean Utility Room and Staff Locker/Shower Rooms. Work includes, but is not limited to, non-bearing partitions, lead

shielding, finishes, casework, equipment anchorage, floor slab cutting and patching, modification to mechanical, plumbing and electrical systems.

- E. Separate areas of work will be identified for non-sequenced phased construction so that each area can be signed off independently of the other

PHASE 1: Cath Lab #2 (1745B), Equipment Closet (1745D), Control Room (1745C) and Scrub Sink

PHASE 2: Women's Staff Locker Room and Restroom (1749)

PHASE 3: Men's Staff Locker Room and Restroom (1748)

PHASE 4: Clean Utility (1747) and Lead Vest Storage Closet (1740G)

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

- G. Build-out as shown and herein specified, complete and ready for occupancy, the following Cath Lab facility shown on the Contract Documents.
- H. Special Constraints and Criteria:
 - 1. Refer to Section 011400 Work Restrictions for dates and hours when the building is occupied and operational, and work-shift hour requirements and restrictions.
 - 2. Noise Mitigation shall be required when the building is occupied.
 - 3. Egress shall not be restricted or impacted unless scheduled when the building is not occupied.

1.03 Contractor WARRANTIES

- 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 48 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 48 of the Contract.

1.05 UNIVERSITY-FURNISHED, CONTRACTOR-INSTALLED (UFCI) 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. Patient Transfer Board
 2. Warming Cabinet
 3. Sharps Disposal Containers
 4. Scrub Dispensers
 5. Medication/Supply Dispensers
 6. Refrigerators/Freezers
 7. Wire Shelving
 8. Glove 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 but not limited to: 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 013100 - COORDINATION for additional requirements.

1.06 UNIVERSITY-FURNISHED, UNIVERSITY-INSTALLED (UFUI) PRODUCTS

- A. University-Furnished Products: University will furnish and install products which may be identified on the Drawing and in the Specifications as UFUI (University-Furnished/University-Installed).
 1. Vendor Imaging, X-Ray Equipment and Equipment/Light Booms will be furnished by the University. Supporting structure, miscellaneous metals and all electrical and low voltage rough in will be provided and installed by the Contractor.
 2. Computer Equipment such as printers, CPU's and Monitors to be furnished and installed by the University.
- B. Relationship to Work Under the Contract: Work under the Contract shall include all provisions necessary to provide all rough-in requirements into the Work, including as

necessary but not limited to 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 013100 - COORDINATION for additional requirements.

1.07 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 the Drawings as NIC (Not in Contract), including the following:

1. Pre and Post Test and Air/Water balance work.

- B. Relationship to Work Under the Contract: Work under the Contract shall include all provisions necessary to make such concurrent work 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.
- C. 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.

1.08 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 the right to back charge **Contractor** for additional work.

1.09 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 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. No Work shall be done outside of standard Monday through Friday 7:00 a.m. to 5:00 p.m. working hours, on holidays or weekends unless prior written approval has been retained from the University's Representative or work activities occur as indicated below.
- D. Work Shifts.
 - 1. The **Contractor** shall provide two work shifts 7:00 a.m. to 5:00 p.m. and 9:00 p.m. to 5:00 a.m. for work that is "noisy" and invasive such as roto-hammering, scarifying of floor, shooting of pins or core drilling during the 9:00p.m. to 5:00

a.m. shift. Each work shift shall use a different Superintendent at no additional cost to the University.

- E. 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 015100 - TEMPORARY UTILITIES for additional requirements.
- F. 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) calendar days' notice of all utility outages and shutdowns.

1.10 UNIVERSITY BENEFICIAL OCCUPANCY

Use only to identify space(s) the University must occupy prior to completion of the entire project.

- A. See 1.11 PROJECT PHASING. The following portions of the Work are designated for occupancy by University as indicated.

1.11 PROJECT PHASING

The WORK OF THIS contract is divided into 4 Phases. Separate areas of work will be identified for non-sequenced phased construction so that each area can be signed off independently of the other:

- A. PHASE 1: Cath Lab #2 (1745B), Equipment Closet (1745D), Control Room (1745C) and Scrub Sink
- B. PHASE 2: Women's Staff Locker Room and Restroom (1749)
- C. PHASE 3: Men's Staff Locker Room and Restroom (1748)
- D. PHASE 4: Clean Utility (1747) and Lead Vest Storage Closet (1740G)

PART II - PRODUCTS – Not Applicable to this Section

PART III - EXECUTION – Not applicable to this Section

END OF SECTION 01 11 00

SECTION 01 14 00

WORK RESTRICTIONS

PART I - GENERAL

1.01 WORK HOURS

- A. No Work shall be done outside of standard Monday through Friday 7:00 a.m. to 5:00 p.m. working hours, on holidays or weekends unless prior written approval has been retained from the University's Representative or work activities occur as indicated below.
- B. Work Shifts.
 - 1. The **Contractor** shall provide two work shifts 7:00 a.m. to 5:00 p.m. and 9:00 p.m. to 5:00 a.m. for work that is "noisy" and invasive such as roto-hammering, scarifying of floor, shooting of pins or core drilling during the 9:00p.m. to 5:00 a.m. shift. Each work shift shall use a different Superintendent at no additional cost to the University.

1.02 PROJECT PHASING

Project is a partial remodel of approximately 2,671SF within the existing Cardiac Cath Lab Department located on the first floor within the Davis Tower 1 Building 12 of the UC Davis Medical Center campus. The project scope included end-of-life equipment replacement, equipment room relocation and upgrades to Cath Lab #2 (Room 1745B), Control Room, Scrub Sink, Adjacent Corridor, Lead Vest Storage, Clean Utility Room and Staff Locker/Shower Rooms. Work includes, but is not limited to, non-bearing partitions, lead shielding, finishes, casework, equipment anchorage, floor slab cutting and patching, modification to mechanical, plumbing and electrical systems.

Separate areas of work will be identified for non-sequenced phased construction so that each area can be signed off independently of the other:

PHASE 1: Cath Lab #2 (1745B), Equipment Closet (1745D), Control Room (1745C) and Scrub Sink

PHASE 2: Women's Staff Locker Room and Restroom (1749)

PHASE 3: Men's Staff Locker Room and Restroom (1748)

PHASE 4: Clean Utility (1747) and Lead Vest Storage Closet (1740G)

1.03 WORK SEQUENCE and WORK RESTRICTIONS

Assume each phase is completed end to end with no overlap with 2 weeks notice minimum provides prior to the start of each phase.

Note that any work in Control Room (1745C) must allow for use of one half of the room by staff for use of the operational Cath Lab. Contractor to coordinate construction barriers with end user's requirements.

1.04 CONTRACTOR'S USE OF PROJECT SITE

- A. **Contractor's** use of the Project site for the Work and storage is restricted to the areas designated on the Drawings.

1.05 UNIVERSITY OCCUPANCY (EDIT or indicate NOT USED)

- A. Contractor to assume all areas outside the areas of work and as phases are completed will be occupied during construction.
- B. Substantial Completion shall be applicable to the entire Work by Phase.

1.06 PROTECTION OF PERSONNEL

- A. Patients, University of California Davis (UCD) personnel and Students, will be occupying parts of the adjacent buildings during the construction period. **Contractor** shall take proper precautions to ensure the safety of all persons during the construction period.

1.07 WORK SITE DECORUM

- A. Extreme care to limit noise shall be taken at all times that the building is occupied. Loud or unnecessary conversation shall be avoided. The playing of radios, or any audio devices shall be strictly prohibited. Noise, that in the sole opinion of the University's Representative, is disturbing or disruptive to occupants of the building shall be scheduled for periods when the building is not occupied.
- B. **Contractor** shall control the conduct of its employees so as to prevent unwanted interaction initiated by **Contractor's** employees with UCD staff, patients, students or other individuals, adjacent to the Project site. Without limitation, unwanted interaction by **Contractor's** employees includes whistling at or initiating conversations with passersby. In the event that any **Contractor's** employee initiates such unwanted interaction, or utilizes profanity, **Contractor** shall, either upon request of University's Representative or on its own initiative, replace said employee with another of equivalent technical skill, at no additional cost to the University.

- C. SMOKE AND TOBACCO-FREE ENVIRONMENT: The University of California Davis is committed to a healthy campus and workplace culture and environment. Effective January 2, 2014, the University of California Davis is a Smoke and Tobacco-Free environment. Smoking and the use of smokeless tobacco products (e.g., e-cigarettes and other unregulated nicotine products) is strictly prohibited on all University of California Davis-controlled properties, owned or leased and regardless of location. This policy is intended to provide a healthier, safer, and productive work and learning environment for the entire University of California Davis community. For more information on the Smoke/Tobacco-Free Policy, please visit (<http://breathefree.ucdavis.edu>). For more information on the President's Mandate and other related resources, please visit <http://uctobaccofree.com/>.
- D. Alcoholic beverages are prohibited on the University's Project site.

1.08 INTERRUPTION OF BUILDING SERVICES

- A. Planned utility service shutdowns shall be accomplished during periods of minimum usage. In some cases, this will require Work activities before 8:00 a.m. and after 5:00 p.m. and weekend Work, at no additional cost to the University. At least 14 calendar days advance notice shall be given to the University's Representative before interruptions to utility service (refer to Utility Service Interruption/Shut Down Request) and other interferences with use of existing buildings, surrounding hardscape and roads.
- B. Shutdowns critical to the completion of the project shall be listed as Milestones on the project schedule. The **Contractor** shall program Work so that service will be restored in the minimum possible time and shall cooperate with the University in reducing shutdowns of utility systems.
- C. The University reserves the right to deny shutdown requests based on scheduled workload, research projects, and usage of surrounding buildings or other activities planned on campus.
- D. University's costs for initial planned utility service shutdowns shall be borne by the University. If repeat utility service shutdowns are required due to work necessary to correct **Contractor's** defective work, mistakes in new work layout such as misalignment or installation conflicts with other new work, University's costs for repeat shutdown(s) will be deducted from Contract Sum.

1.09 SITE INGRESS AND EGRESS

- A. Access to Project site shall be as indicated on the Drawings. Access to Project site is limited to designated routing on existing access roads. The **Contractor** and their employees, sub**contractors**, suppliers or delivery personal must stay on the designated roads and may not drive, ride or walk to other locations unless prior permission is provided in writing by the University's Representative.
- B. **Contractor** shall take all necessary precaution to ensure the safety of the bicyclists and pedestrians that use the campus roads.

- C. **Contractor** shall clean the site access and roads affected by the Work and shall maintain such in a dust free and safe and usable condition for motorists, bicyclists and pedestrians. During inclement weather **Contractor** shall closely monitor conditions to prevent slickness of roads.
- D. **Contractor** shall be permitted to block only 1/2 of a street at a time for momentary site access, unless specified otherwise. The street shall be operational and usable by the University at all times.

1.10 MOTOR VEHICLE AND BICYCLE TRAFFIC CONTROL

- A. **Contractor** shall adopt all practical means to minimize interference to traffic. Access to other facilities in the area shall be maintained at all times. The **Contractor** shall provide a schedule of any activity that will impact traffic, or any planned lane or street closure, for approval by the University's Representative and shall give a minimum of 14 business days notice before closing any street or access.
- B. **Contractor** shall furnish at **Contractor's** expense all signage barricades, lights, and flaggers required to control traffic and shall provide and maintain suitable temporary barricades, fences, directional signs, or other structures as required for the protection of the public; and maintain, from the beginning of twilight through the whole of every night on or near the obstructions, sufficient lights and barricades to protect the public and Work.
- C. **Contractor** shall provide directional signs for use throughout the duration of the Project. The quantity shall be determined by the University's Representative and **Contractor** during a mandatory Pre-construction site meeting. **Contractor** shall prepare a mock-up of the sign for approval by the University's Representative.
- D. It is the responsibility of the **Contractor** performing Work on, or adjacent to, a roadway or highway to install and maintain such devices which are necessary to provide reasonably safe passage for the traveling public, including pedestrians and bicyclists, through the Work, as well as for the safeguard of workers. Before Work begins, a site meeting shall be held to discuss motor vehicle and bicycle traffic control plans for handling traffic through a construction or maintenance zone. Traffic control plans shall be submitted for review by the University's Representative and public agency or authority having jurisdiction over the roadway or highway. These traffic control plans shall be prepared by persons knowledgeable about the fundamental principals of temporary traffic controls and the work activities to be performed. The design, selection, and placement of traffic control devices for the traffic control plan shall be based on engineering judgment and in accordance with Part 6 of the California Manual on Uniform Traffic Control Devices for Streets and Highways.

- E. All metal plating and metal bridging shall be non-skid with waffle-patterns or right-angle undulations or shall be coated with a non-skid product. Plating shall be installed with no protruding edges or corners sticking up and with no bouncing or shifting.

PART II - PRODUCTS – Not applicable to this Section.

PART III - EXECUTION – Not applicable to this Section.

END OF SECTION 01 14 00

SECTION 01 23 00

ALTERNATES

PART I - GENERAL

1.01 GENERAL

- A. This Section identifies each Alternate and describes basic changes to the Work only when that Alternative is made a part of the Work by specific provision in the Agreement.
- B. Lump Sum Base Bid and Alternates shall include costs of all supporting elements required, so that combination of Lump Sum Base Bid and any Alternates shall be complete. Scope of Work for all Alternates shall be in accordance with applicable Drawings and Specifications.
- C. Except as otherwise specifically provided by University, Work described in Alternates shall be completed with no increase in Contract Time.
- D. This Section includes only non-technical descriptions of the Alternates. Refer to Sections of Division 2 - 48 of the Specifications for technical descriptions of the Alternates.
- E. Coordinate related Work and modify surrounding Work as required to integrate Alternates into the Work properly and completely.

1.02 DESCRIPTION OF ALTERNATES

- A. NOT USED

PART II - PRODUCTS – Not Applicable to this Section

PART III - EXECUTION – Not applicable to this Section

END OF SECTION 01 23 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

- A. Conditions of the Contract: Governing requirements for changes in the Work, in Contract Sum and Contract Time.
- B. Section 016100 – 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, or electronic and/or web-based construction administration software provided or accepted by the University.

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 RFIs 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. Email the University's Representative the RFIs. Emailed RFI requests received after normal business hours and/or received on non-normal workdays, as defined in

Specification Section 013100—COORDINATION, Item 1.07.F.4.A will begin notification time starting at 7:00 a.m. the following workday.

- B. Failure to provide proper information: RFIs 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) calendar 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.

3.02 Refer to the following Attachment

- A. Request for Information

END OF SECTION 01 25 00

REQUEST FOR INFORMATION

Project #: _____ **Project Title:** _____
RFI #: _____ **Date:** _____ **HCAI #:** _____

UC Davis Health Facilities Design & Construction 4800 2 nd Avenue, Suite 3010, Sacramento, CA 95817 Attn.: Aaron Allen C: 916-397-1086 Email: aamallen@ucdavis.edu	From:	

SUBJECT: _____

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

TRANSMITTAL RECORD	Requestor to FD&C	FD&C to A/E	A/E to FD&C	FD&C to Requestor	Notes
Date Submitted					

INFORMATION NEEDED: _____

CONTRACTOR'S PROPOSED RESOLUTION: _____

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

☐ **ATTACHMENTS:** _____

REPLY: _____

REPONDER SIGNATURE: _____ **DATE:** _____

UNLESS OTHERWISE INDICATED ABOVE, THE REPLY TO THIS RFI IS NOT INTENDED TO BE A CHANGE DIRECTIVE. SHOULD THE CONTRACTOR, SUBCONTRACTOR, OR SUPPLIERS FEEL THAT THE REPLY WILL IMPACT THE PROJECT COST OR SCHEDULE; IT SHOULD IMMEDIATELY BE CONVEYED TO THE UNIVERSITY'S FD&C PROJECT MANAGER IN ACCORDANCE WITH THE CONTRACT DOCUMENTS.

COPIES: ☐ University ☐ CONSULTANTS ☐ _____ ☐ _____ ☐ _____ ☐ FILE

SECTION 01 25 50

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. Cost Proposals and Supporting Documentation
- I. Execution of Change Orders
- J. Reconciliation of Change Orders

1.02 RELATED DOCUMENT SECTIONS

- A. General Conditions of the Contract: Governing requirements for changes in the Work, in Contract Sum and Contract Time.
- B. Section 012500 – CLARIFICATION/INFORMATION PROCEDURES
- C. Section 012900 – MEASUREMENT AND PAYMENT: Applications for Payment.
- D. Section 016100 – PRODUCT REQUIREMENTS: Product options, substitutions, omissions, and improper descriptions.
- E. Section 017700 – CLOSEOUT PROCEDURES: Project record documents.

1.03 DEFINITIONS

- A. Total Wage Rate: Base rate paid to the worker, including his/her fringe benefits, workman's compensation insurance and subsequent payroll taxes paid by the employer.
 - 1. Use Wage Rate Calculator issued with Division One.
 - 2. Projects in the University Controlled Insurance Program (UCIP) should not include workman's compensation in the wage rates.

- B. Consumables: Material purchased in bulk and not expressly accounted for in the listed materials on a change order request. These include but are not limited to, rags, washers, screws, nuts, small bolts, lubricants, cleaning materials, pens, chalk, pencils, tie wire, caution tape, etc. Compensation for consumables shall be incorporated as a 3% percentage increase on direct material costs for trades where these items are routinely used.
- C. Non-working Supervision: Non-working supervision is not allowed to be included on a change order per GC article 7.3.3.

1.04 SUBMITTALS

- A. Submit the items listed below prior to submitting the 2nd Application for Payment.
 - 1. Total Wage Rates: Provide a wage rates for each key worker of the General Contractor and all Subcontractor tradespeople using the University's digital form for review and in compliance with the general conditions article 7 for approval by the University. Approved rates will be used in the Exhibit 7 Labor Rate Breakdown forms submitted with each Cost Proposal.

1.05 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. Exhibit 7 of the Contract includes the following Forms:
 - 1. COST PROPOSAL Form
 - 2. SUPPORTING DOCUMENTATION FOR THE COST PROPOSAL SUMMARY Form
 - 3. CHANGE ORDER Form
 - 4. REPORT OF SUBCONTRACTOR INFORMATION Form

1.06 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.

1.07 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) calendar 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 016100 – PRODUCT REQUIREMENTS.

1.08 FIELD ORDER

- A. Field Order: University's Representative may issue a Field Order, signed by University's Representative, instructing the Contractor to proceed immediately 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 indicated in the Field Order prior to acceptance of a Cost Proposal for the Work by the University.
- 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.

1.09 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 CONTENT OF COST PROPOSALS

- A. Cost Proposals shall include the following:
 - 1. Detailed description of the work involved including:
 - a. What work is being performed?
 - b. Where the work is performed?
 - c. When the work was performed if already completed?
 - d. When the work is scheduled to be performed if not yet completed?
 - e. Why this work is a change to the contract?
 - 2. Detailed description of any time impacts associated with the work; refer to General Conditions, paragraph 8.4.
 - 3. Materials
 - a. Material shall be submitted at the cost paid by the contractor.
 - 1) Invoices may be required to validate that meet the following criteria:
 - a) Invoices may be from different projects if the following conditions are met:
 - (1) The COR is before the contractor would reasonably have the material on site to accomplish the COR.
 - (2) Recent, within last 6 months.
 - (3) There must be at least enough of the material in question to accomplish the work in the proposed COR.
 - b) The invoice shall not be modified from the version provided by the vendor.
 - 4. Labor unit breakdown backed up by some sort of industry standard (NECA for electrical, MCAA for plumbing and mechanical, SMACNA for mechanical, Etc.) These standards shall be used at their base rate, with no added percentages nor adjustments. This has been found to be a fair representation of the man-hours required to do these types of work.
 - a. This project has been determined as NECA normal.

5. Wage rate back up matching the submitted back up as described in 1.03.A.
- B. Submittal of a Cost Proposal using the Cost of the Work plus Contractor Fee described in General Conditions paragraphs 7.3.5 and 7.3.6 shall include the following items in addition to those listed above:
 1. Field Order instructing the change. Only a field order may instruct work to be completed using this basis.
 2. Material invoices shall be provided for any item used in Extra Work.
 3. Job site work tags identifying daily labor and material usage shall be submitted with:
 - a. Specific description of the work performed on that tag.
 - b. Identification of large equipment used
 - c. Identification of labor class for each individual
 - d. Location - room number, gridline or distinct location.
 - e. Signed by the Contractor and University's Representative.
- C. Any coordination required for implementation of a change into the work, documents, or model is and shall be considered part of the allowable markups provided in General Conditions paragraphs 7.3.3.1-18 and 7.3.4.

3.02 EXECUTION OF CHANGE ORDERS

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

3.03 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 50

SECTION 01 29 00**MEASUREMENT AND PAYMENT****PART I - GENERAL****1.01 SECTION INCLUDES**

- A. Procedures for preparation and presentation of Application for Payment.
- B. Procedures for preparation and presentation of Schedule of Values.

1.02 RELATED DOCUMENTS AND SECTIONS

- A. GENERAL CONDITIONS of the Contract: Progress Payments and Final Payment.
- B. Section 013200 – CONTRACT SCHEDULES
- C. Section 017700 – CLOSEOUT PROCEDURES
- D. Section 017800 – CLOSEOUT SUBMITTALS

1.03 PAYMENT APPLICATION FORM

- A. Payment Application Form: Prepare Applications for Payment using Exhibit 4 provided in the Contract.

1.04 SCHEDULE OF VALUES

- A. Coordination. Coordinate preparation of the Schedule of Values with preparation of the Contractor's Contract Schedule and as directed by the University's Representative.
 - 1. Correlate line items in the Schedule of Values with other required administrative schedules and forms, including:
 - a. Contractor's Contract Schedule.
 - b. Application for Payment form.
 - c. List of Subcontractors.
 - d. List of products (where/if appropriate).

- e. List of principal supplier and fabricators.
 - f. Submittal Schedule
 - g. Construction Cost Breakdown Sheet.
 - 2. Submit the Schedule of Values to the University's Representative at the earliest feasible date, but in no case later than 7 calendar days before the date scheduled for Submittal of the Initial Application for Payment.
- B. Format and Content. Use the Specification Table of Contents as a guide to establish the format for the Schedule of Values.
- 1. Include the following Project identification on the Schedule of Values:
 - a. Project name and location.
 - b. Name of the University's Representative.
 - c. Project Number.
 - d. Contractor's name and address.
 - e. Date of Submittal.
 - 2. Arrange the Schedule of Values in a tabular form with separate columns to indicate the following for each item listed:
 - a. Generic name.
 - b. Performance Specification or University Specification section.
 - c. Name of Subcontractor.
 - d. Name of manufacturer or fabricator.
 - e. Name of supplier (if appropriate).
 - f. Change orders (number) that have affected value.
 - g. Dollar value. (Percentage of Contract Sum to the nearest one-hundredth percent, adjusted to total 100 percent.)

3. Provide a breakdown of the Contract Sum in sufficient detail to facilitate continued evaluation of Applications for Payment and progress reports. Break principal subcontract amounts down into several line items.
4. Round amounts off to the nearest whole dollar; the total shall equal the Contract Sum.
5. For each part of the Work where an Application for Payment may include materials or equipment, purchased or fabricated and stored, but not yet installed, provide separate line items on the Schedule of Values for initial cost of the materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
 - a. Differentiate between items stored on-site and items stored off-site. Include requirements for insurance and bonded warehousing, if required.

6. Provide separate line items on the Schedule of Values for initial cost of the materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
7. Contractor's General Conditions overhead and profit shall be a separate line item per month.
8. Allowances (if applicable). Show the line item value of allowances.

1.05 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 in PDF electronic file on the required forms. Media-driven forms are acceptable.
 2. Execute certification by verified electronic signature of authorized officer of the Contractor.
 3. Use data from the approved Schedule of Values. Provide dollar value in each column of application for each line item and portion of Work performed and for products stored, if permitted.
 - a. List value of each major item of Work and each subcontracted item of Work as a separate line item to serve as a basis for computing values for progress Payments. Round off values to nearest dollar. Listed items of work shall be identified by Specification Section number.
 - b. List products and operations of each major subcontract as separate line item.
 - c. Include Work Allowances (if any) within line item of Work.
 - d. Coordinate percentage complete with Progress Schedule.
 - e. Provide separate line items for each area of work such as but not limited to floors, zones, wings, or other areas that can be clearly identified.
 - f. 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.
 6. Refer to 1.05 for other items required for the Application for Payment.
- B. Final Payment: Prepare Application for Final Payment as specified in Section 017700 – CLOSEOUT PROCEDURES.

1.06 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 one (1) PDF electronic file of each Application for Payment with verified electronic signature, such as DocuSign. 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 013200 – CONTRACT SCHEDULES.
 3. Submit one (1) PDF electronic file of Schedule of Values in accordance with the General Conditions of the Contract. Form and content shall be acceptable to the University. Transmit under PDF electronic transmittal letter. Identify University's Project Name and University's Project Number.
 - 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. Each value will be based on a percent complete of that line item.
 - b. For each major subcontract, list products and operations of that subcontract as separate line items.
 - c. Coordinate listings with Progress schedule. Contractor project General Conditions plus overhead and profit shall be a separate line item in the Application for Payment; and be divided in an equal amount for each month part of the Contract Time period.

- 1) At 50 percent completion of the work, or at other times the University's Representative deems appropriate, the University's Representative may request the monthly amount of overhead and profit be adjusted, if the contract schedule indicates going beyond the Contract End Date.
- d. For items on which payments will be requested for on-site stored products, list sub-values for cost of on-site stored products with taxes paid. If stored products are not on-site, they must be stored in a bonded warehouse or location approved by the University's Representative prior to including on the Application for Payment.
- e. Submit a sub-schedule for each separate Phase of Work specified in Section 011100. Include scheduling of sequences within each phase indicated on the drawings.
- f. The Sum of values listed shall equal total Contract Sum.
- g. When University's Representative requires substantiating information, submit data justifying line-item amounts in question.
- h. Provide one (1) PDF electronic file 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 PDF electronic transmittal letter. Contractor shall identify all payment application documents by University's Project Name and University's Project Number.

1.07 SUBSTANTIATING DATA

- A. University's Representative may request substantiating information. Submit data reconciling line-item amounts in question.
- B. Provide one (1) PDF electronic file of data with cover letter for each copy of submittal. Show Application number including date and line item by number with 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 011100 – SUMMARY OF THE WORK: Description of Contract Documents.
- B. Section 013200 – CONTRACT SCHEDULES
- C. Section 013300 – SHOP DRAWINGS, PRODUCT DATA AND SAMPLES
- D. Section 013500 – SPECIAL PROCEDURES: Interim Life Safety Measures (ILSM).
- E. Section 014500 – QUALITY CONTROL
- F. Section 014550 – INSPECTION AND TESTING OF WORK
- G. Section 015100 – TEMPORARY UTILITIES
- H. Section 015200 – CONSTRUCTION FACILITIES
- I. Section 015500 – VEHICULAR ACCESS AND PARKING: Traffic Regulation.
- J. Section 015600 – TEMPORARY BARRIERS, ENCLOSURES AND CONTROLS
- K. Section 015610 – AIRBORNE CONTAMINANTS CONTROL
- L. Section 016100 – PRODUCT REQUIREMENTS
- M. Section 017300 – CUTTING AND PATCHING
- N. Section 017700 – CLOSEOUT PROCEDURES: Coordination of completion reviews, inspections, and submission of documents.

- O. Section 017800 – CLOSEOUT SUBMITTALS: As-Built Documents.
- P. Division 21 - Fire Protection Systems.
- Q. Division 28 - Fire Alarm Systems

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) calendar 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 013100 – COORDINATION.
 - b. Subcontractors List: Provide PDF electronic file. Distribute and discuss list of subcontractors and suppliers.
 - c. Construction Schedule: Provide per Section 013200. Distribute and discuss initial construction schedule and critical work sequencing of major elements of Work, including coordination of University furnished/Contractor installed (UFCI) products, University furnished/University installed (UFUI) 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, electronic 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: Provide per Section 013300 and Section 016100. Review administrative procedures for shop drawings, project data and sample submittals and review of preliminary submittals schedule.
 - i. Project As-Built Documents: Provide per Section 017700 and Section 017800. Review requirements and procedures for project as-builts, specifications and other documents.
 - j. Construction Facilities and Temporary Utilities: Provide per Section 015100 and Section 015200. 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 and UFUI 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: Provide per Section 014550 and other sections of the Contract. 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.
 - o. Hours of Work and Work Restrictions per Section 011400.
 - p. Hot Works Permit.
- 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. Prior to the Billing Meeting the

Contractor will submit a draft of the Application for Payment for review by the IOR and University Representative.

- 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 an electronic file within four (4) workdays 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) UFCI and UFUI products.
 - 5) Request for Information
 - 6) Safety Issues
 - 7) Scheduling Status/1 Week Prior and 32 Week Look Ahead
 - 8) Potential Schedule Delay Issues
 - 9) Incomplete or Non-Conforming Work
 - 10) Inspection Requests
 - 11) Utility Shutdowns and Dig Notifications
 - 12) Instructional Bulletins and Field Orders
 - 13) Change Orders/Cost Proposals
 - 14) Payment Applications and As-Built Documents
 - 15) Miscellaneous Business
 - 16) 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.
 - 1. 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.
- F. 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 013300 – SHOP DRAWINGS, PRODUCT DATA AND SAMPLES, Section 017700 – CLOSEOUT PROCEDURES and Section 017800 – 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 Division 21
 - b. Fire Alarm System: Refer to Division 28
 - c. Additional HCAI Deferred Approvals: Refer to list of deferred approvals as shown on the Contract Documents.
- B. Coordination/Engineering Drawings: Submit in accordance with Section 013300 – 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 017700 – 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 to move University equipment and/or provide furnishings in the project area. Contractor shall notify University's Representative in writing a minimum of fourteen (14) calendar days prior to completion of area described above.
 - 1. Contractor shall show this time as a distinct activity on the detailed project schedule.]]
- B. Equipment Coordination: Contractor and University supplied equipment will require complete installation data be exchanged directly between Contractor and vendors and subcontractors involved as progress of Project requires. Individual requesting information shall advise when it is required. Incorrect, incomplete, delayed or improperly identified equipment causing delay or error in installation will require entity causing such action to be liable for modifications or replacements necessary to provide correct and proper installation, including relocations.
- C. Contractor shall provide large scale 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) calendar days prior to desired digging activity.
2. The Contractor shall contact USA North 811 prior to starting underground Work to locate existing underground utilities.
 3. Contractor shall mark locations of all known utilities on ground of dig area with marker paint.
 4. 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.
 5. Contractor shall verify with University's Representative that all interested hospital departments have been notified of intent to begin digging operation.
 6. 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, the University reserves the right to back charge the Contractor for this effort required to support such shutdown.
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 shut down.
 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) calendar 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 the 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 a.m. and after 5:00 p.m. 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: Refer to Section 017600. 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 be submitted as a PDF electronic file with Table of Contents indexed. 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: Contractor shall provide a complete set of Coordination/ Engineering Drawings that indicates the architectural and structural building components; and combines all piping, conduits, fire sprinkler system, equipment, hangers, braces and other building components into one composite drawing for each floor, wing or area of work. Submit the Coordination/ Engineering Drawings as a bookmarked PDF electronic file. These drawings are for the Contractor's and University's use during construction and shall not be construed as replacing any shop drawings, "As-Built", 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 $\frac{1}{4}" = 1' - 0"$ 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 above and below ceiling spaces for new and existing conditions, including bottom of all ducts, plenum, pipe and conduit elevations. Drawings shall show all structural and architectural components, restraints and other obstructions that may affect the work. Electronic or photo reproduction of University's Architectural Drawings is not acceptable.
 - b. Contractor and each Subcontractor shall ensure all relevant mechanical and electrical equipment, piping, conduit, fire sprinkler system, ceiling

hangers, braces etc., are shown and will fit, together with necessary items such as lights, ducts, fans, pumps, piping, conduit and the like.

- c. Contractor shall indicate all locations of expansion/ seismic joints and indicate how expansion for piping, conduit and other components is provided.
- d. Contractor shall indicate all locations for access doors or other means of access at conditions above and below for items requiring access or service including but not limited to valves, mechanical equipment, electrical equipment valves and other components. The Contractor is responsible that piping, conduit, braces and other obstructions do not block access to items indicated above.
- e. Submit completed and fully coordinated PDF electronic indexed file drawings with bookmarked Sheet Index together with Contractor's comments indicating possible areas of conflict for review to University's Representative prior to start of work.
- f. Penetrations: Contractor shall prepare a sleeving layout (1/4" scale) indicating size and locations of sleeves. Trades shall indicate to Contractor their requirements and locations. PDF electronic files to applicable trades and University's Representative.
- g. Completion of work: All coordination drawings shall be submitted together with record (as built) drawings of all trades involved in accordance with Section 013300 – SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.

PART II - PRODUCTS – Not Applicable to this Section

PART III - EXECUTION

3.01 Refer to the following attachments

- A. Request for Shutdown (RFS) Info/Impact Report
- B. Dig Notification Form

END OF SECTION 01 31 00

REQUEST FOR SHUTDOWN (RFS) INFO/IMPACT REPORT

PROJECT NAME: _____

UNIVERSITY RFS# _____

PROJECT #: _____ HCAI #: _____ CONTRACTOR RFS #: _____

TODAY'S DATE: _____ SHUTDOWN DATE: _____ SUSPEND DATE: _____

TO: UC DAVIS HEALTH Facilities Design & Construction 4800 2 nd Avenue, Suite 3010 Sacramento, CA 95817 P: 916-734-7024 Project Manager's email address:	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: _____

DIG NOTIFICATION FORM

PROJECT #: _____ HCAI#: _____ DATE: _____

TO: UC DAVIS HEALTH
Facilities Design & Construction
4800 2nd Avenue, Suite 3010
Sacramento, CA 95817
P: 916-734-7024

FROM: _____

Project Manager's email address: _____

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: **University** _____ **Consultants** _____ **File** _____

SECTION 01 32 00

CONTRACT SCHEDULES

PART I - GENERAL

1.01 SCOPE

- A. Preliminary Contract Schedule, Contract Schedule, updated Contract Schedules, Short Interval Schedules (SIS), Recovery Schedules and As Built Schedule.
- B. Sub-networks of activities (Fragnets) supporting Time Extension Requests.

1.02 DEFINITIONS

- A. Construction Schedule/CPM Schedule/Schedule: The most recent; Baseline Schedule, Updated Schedule or Revised Schedule.
- B. Final Baseline Schedule: A final and ongoing Schedule for the project that has been reviewed and accredited by the University's Representative
- C. Critical Work activities are defined as Work activities that, if delayed or extended, will cause a critical delay as defined in General Conditions Article 8. All other Work activities are defined as non-critical Work activities and are considered to have float.
- D. Float is defined as the time that a non-critical Work activity can be delayed or extended without causing a critical delay as defined in General Conditions Article 8. Neither the Contractor nor the University shall have an exclusive right to the use of float. Float is a shared resource available to each party to the contract. The Contractor shall document the effect of the use of float on the updated Contract Schedule.
- E. Recovery Schedule: Schedule required when any Revised Schedule or Update Schedule shows the work to be more than 14 calendar days behind the latest University-accepted contract end date
- F. Short Interval Schedule (SIS): Schedule prepared on a weekly basis demonstrating the work accomplished the prior week and work planned for the upcoming three weeks.

1.03 SUBMITTALS

- A. Submit the following in accordance with Section 01 33 00 Shop Drawings, Product Data, Samples:
 - 1. Proposed Scheduling Software and qualifications of individual preparing schedules.
 - 2. Preliminary Contract Schedule
 - 3. Contract Schedule including graphical and tabular reports.
 - 4. Monthly Updates to Contract Schedule, including Narrative Report.
 - 5. Short Interval Schedules
 - 6. Final As-Built Schedule
- B. Include an electronic version of all submittals required by this specification, including Narrative prepared in MS Word or .pdf format, CPM schedule in .xer file (P6 backup) or other schedule native file format if accepted under 1.3. A.1 above, .pdf of full schedule, and .pdf of critical path. The following fields shall be included:
 - 1. Activity identification
 - 2. Activity description
 - 3. Duration, start, and finish dates.
 - 4. Percentage of completion
 - 5. Total float
 - 6. Responsible party
 - 7. Predecessors and successors

PART II - PRODUCTS

2.01 SOFTWARE

- A. The Contractor shall use Primavera P6 by Oracle Corporation, or equal to produce the schedule and all required graphical and tabular reports.

PART III - EXECUTION

3.01 PRELIMINARY CONTRACT SCHEDULE

- A. Within 10 calendar days after the Notice of Selection as the Apparent Lowest Responsible Bidder, Contractor shall submit the Preliminary Contract Schedule in both native and .pdf format to the University's Representative for acceptance. The Preliminary Contract Schedule shall represent the Contractor's plan for accomplishing the work within the Contract time showing all significant milestones for the Contract period as well as a detailed work plan for the first 90 calendar days following the Notice to Proceed. This detailed work plan shall identify in detail the following activities for the first 90 calendar days:
1. Preparation of equipment and material submittals for review. List Project submittals within Schedule per each specification section including Division 1 requirements. Indicate dates for submission of required submittals. Note: schedule shall include 18 calendar days for the University's review of the Preliminary Contract Schedule.
 2. Make submissions within the following number of days after the Notice to Proceed:
 - a. Items needed in initial stages of Work or requiring long lead-time for ordering: 30 calendar days.
 - b. Deferred approval submittals, for review and approval by agencies such as University's when required: 60 calendar days.
 - c. Electrical, mechanical and equipment items other than those covered by item "a" above: 60 calendar days.
 - d. All other items: 90 calendar days.
 3. Procurement schedule.
 4. Critical Path for the first 90 calendar days.
- B. The Preliminary Contract Schedule shall acknowledge significant known constraints and include all anticipated activities prior to the Notice to Proceed.
- C. The Preliminary Contract Schedule shall not include any actual dates or progress measured against any activities.
- D. Acceptance of the Preliminary Contract Schedule is a condition for approval of the first progress payment application.
- E. The Contractor's progress shall be measured against the Preliminary Contract Schedule until such time as the University accepts the Contractor's first Contract Schedule. The Preliminary Contract Schedule shall be incorporated into the Contractor's proposed Contract Schedule.

- F. Unless approved by the University's Representative, there shall be no activities shown with durations greater than 14 calendar days (excluding submittals, submittal reviews, and procurement activities).

3.02 CONTRACT SCHEDULE (BASELINE)

- A. The Contract Schedule shall represent a practical plan to fully complete the Contract within the Contract Time. The Contract Schedule shall include a complete sequence of construction, in adequate detail for coordination of the Work and shall be coordinated with the preparation of the Schedule of Values per 01 29 00 Measurement and Payment.

B. Form

1. The proposed first contract schedule shall be produced using CPM (Critical Path Method) techniques, in the PDM (Precedence Diagram Method) method of scheduling. The Contract Schedule shall be calculated using the Retained Logic method. Progress override calculations shall not be acceptable. The schedule shall not use negative float or constraints on work activities.
2. The Contract Schedule shall identify all holidays and non-working days.
3. Identity of the party responsible for the activity (i.e., University, General Contractor, specific subcontractor, etc.)
4. The Contract Schedule activities shall be coded with the following information applicable to each activity:
 - a. Area of the project
 - b. Identity of the party responsible for the activity (i.e., University, General Contractor, specific subcontractor...)
 - c. Specification section applicable to activity
 - d. Phase
 - e. Sequence – The following sequences shall be identified:
 - 1) Administrative
 - 2) Submittal and Review
 - 3) Fabrication
 - 4) Construction: including phasing and sequencing as identified in 011400 Work Restrictions
 - 5) Inspection, Commissioning, and Close-out

C. Content

1. The Contract Schedule shall identify all Work activities in correct sequence for the completion of the Work within the Contract Time. Work activities shall include the following:
 - a. Major Contractor-furnished equipment, materials, and building elements, and scheduled activities requiring submittals or University's Representative's prior acceptance.
 - 1) Show dates for the submission, review, and approval of each such submittal. Dates shall be shown for the procurement, fabrication, delivery, and installation of major equipment, materials, and building elements, and for scheduled activities designated by the University.
 - 2) The schedule shall allow submittal review time in accordance with Section 01 33 00 Shop Drawings, Product Data, Samples.
 - b. System test dates.
 - c. Scheduled overtime Work to the extent permitted by Contract Documents.
 - d. Dates Contractor requests designated workspaces, storage area, access, and other facilities to be provided by the University.
 - e. Dates Contractor requests orders and decisions from the University on designated items.
 - f. Dates Contractor requests University-furnished equipment.
 - g. Dates Contractor requests University-furnished utilities.
 - h. Planned dates for shutdown, connection and relocation of existing utilities.
 - i. Planned dates for connecting to or penetrating existing structures.
 - j. Planned dates for scheduled inspections as required by Codes, or as otherwise specified.
 - k. Commissioning Sequence and activities for all Building Systems.
2. Unless approved by the University's Representative, there shall be no activities shown with durations in excess of 7 calendar days (excluding submittals, submittal reviews, and procurement activities). Milestones should be listed for the completion of wings, floors, and other similar areas.
3. The allowable monthly rain days per the Supplemental Conditions shall be incorporated into the Schedule.
4. Identify types of calendars used and the logic of their application.

D. Submission

1. The first Contract Schedule shall be submitted to the University not later than 30 calendar days after Notice to Proceed. The period covered by Contract Schedule shall be the Contract Time as specified in the Notice to Proceed. The Contract Schedule shall incorporate the logic of the Preliminary Contract Schedule covering the first 90 calendar days following the Notice to Proceed. Items to be included with first submission:
 - a. Contract Schedule (Baseline)
 - b. Critical Path Schedule excluding all non-critical Work activities.
 - c. Narrative
2. Tabular Computer Reports
 - a. As requested by the University, the Contractor shall submit various computer-generated tabular reports.
 - b. As requested by the University's Representative, the Contractor will be required to submit additional Schedule Reports.

E. Acceptance

1. Upon receipt, the University's Representative shall review the proposed first Contract Schedule. Within 21 calendar Days of the University's receipt of the proposed first Contract Schedule, the University's Representative shall schedule a review meeting with the Contractor for the purpose of jointly reviewing the proposed first Contract Schedule.
2. If the proposed first Contract Schedule is accepted by the University's Representative, it shall become the Contract Schedule (or Baseline Schedule). Such acceptance shall not relieve Contractor from its responsibility to fully complete the Contract within the Contract Time, nor shall it relieve Contractor from sole responsibility for any errors in the Contract Schedule.
3. If the Contractor or the University's Representative determines the proposed first Contract Schedule to need revision, the Contractor shall revise and resubmit the proposed first contract schedule to the University's Representative within 14 calendar days for acceptance. If accepted, it shall become the Contract Schedule. Such acceptance shall not relieve Contractor from its responsibility to fully complete the Contract within the Contract Time, nor shall it relieve Contractor from sole responsibility for any errors in the Contract Schedule. If not accepted the Contractor will resubmit within 10 calendar days for a new review period to start.

- a. No progress payment beyond the second progress payment will be paid to the Contractor until such time as the University's Representative has approved the Contractor's first proposed Contract Schedule.

F. Schedule Logic

1. Activity schedule logic should normally be of Finish-to-Start relationship type and assembled to show order in which Contractor proposes to carry out the Work. The logic should indicate restrictions of access, availability of Work areas, and availability and use of manpower, materials, and equipment. Form basis for assembly of schedule logic on the following criteria:
 - a. Indicate which activities must be completed before subsequent activities can be started.
 - b. Indicate which activities can be performed concurrently.
 - c. Indicate which activities must be started immediately following completed activities.
 - d. Indicate resource sequencing due to availability or space restrictions.
 - e. Lags shall not be used if can be represented with additional schedule detail. Finish-to-start logic ties with positive lags are not permitted. All positive time consumption should be represented by a schedule activity. Start-to-start, or finish-to-finish logic ties with negative lags are not permitted.
 - f. Lags in Start-to-Start or Finish-to-Finish relationships must not exceed the duration of the predecessor or successor activity, respectively.

G. Non-Sequestering of Float

1. Contractor shall not sequester float through scheduling techniques, including, but not limited to, constrained dates, extending Work Activity duration estimates, using preferential logic, such as lag or negative lag (lead), unless specifically requested in writing and approved by University's Representative. It is acknowledged that University-caused or Contractor-caused time savings to 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 Contractor.

H. Out of Sequence Logic:

1. Resolution of conflict between actual work progress and schedule logic: When out of sequence activities develop in Schedule because of actual construction progress, Contractor shall submit revision to schedule logic to conform to current status and direction and include reasons in schedule update Narrative.

I. Preferential Logic:

1. The intended purpose of scheduling on a construction project is to help ensure that Contractor's work on the project is adequately planned, tracked and managed. A construction schedule can be as simple as a list of activities, organized in a logical sequence, and time scaled. The concept of construction scheduling is to see that all activities necessary to complete the work, in accordance with the contract documents requirements, are properly planned, coordinated and managed. When Contractor's schedule activities are not sequenced in the most logical manner, but rather, in a manner as to create the maximum possible opportunity for University interference to claim delay or interruption, the University will reject the schedule with a request of different sequence of activities.

3.03 EXPERIENCE REQUIREMENTS

- A. Contractor shall designate an individual from Contractor's staff or a consultant who shall be responsible throughout the duration of the project for preparation of all schedules and reports as required by this specification. This individual shall also be required to attend all meetings with the University's Representative as required by this specification. The Contractor shall demonstrate to the satisfaction of the University that the individual or consultant has at least 3 years of experience preparing, maintaining, and administering detailed project schedules on projects of the same or similar size and complexity as this project. The Contractor shall also demonstrate to the satisfaction of the University that the individual or consultant is proficient in the use of the scheduling software proposed for use by the Contractor on this project.
- B. Within 14 calendar days after the Notice of Selection as the Apparent Lowest Responsible Bidder, Contractor shall provide the University with the identification, qualifications, and experience of and references for the proposed individual or consultant.

3.04 MONTHLY UPDATES

- A. After acceptance of the first proposed Contract Schedule, Contractor shall update the Contract Schedule monthly. The update shall reflect progress as of the end of each month. Contractor shall submit monthly schedule update to the University's Representative for acceptance with the draft payment application and no later than the tenth day of the following month. The updates shall be made as follows:
 1. The Monthly updates shall report progress based upon percent complete of each activity or remaining duration. Actual start dates shall be recorded for those activities that have started. Actual finish dates shall be recorded for those activities that are completed. Activities that are in progress shall reflect an actual start date and the percentage completion for the activity. Actual dates shall be clearly distinguishable from projected dates.
 2. The updated Contract Schedule shall reflect an up-to-date status of the contract work as completed, and materials furnished and in permanent place that qualify for payment.
 3. The updated Contract Schedule shall reflect Contract Time changes included in all processed change orders for the progress month and each preceding month.

- B. Within 5 calendar days after receipt of the updated Contract Schedule in conjunction with the Application for Payment, the University's Representative shall review both and determine which work and material pay items qualify for payment; the approved data will then be returned to the Contractor for input. Within 14 calendar days, the Contractor and the University's Representative shall meet to review the Construction CPM Schedule and discuss any changes required.
- C. The Contractor shall then revise and resubmit (if required) the Updated Contract Schedule and Application for Payment to the University's Representative for payment approval.
- D. The monthly update shall be calculated using retained logic with a required finish date specified as the current contract completion date. Progress Override calculations shall not be acceptable.
- E. No Applications for Payment will be processed, nor shall any progress payments become due until updated Contract Schedules are accepted by University's Representative. The accepted, updated Contract Schedule shall be the Contract Schedule of record for the period it is current and shall be the basis for payment during that period. Acceptance of any updated Contract Schedules shall not relieve Contractor] from its responsibility to fully complete the Contract within the Contract Time, nor shall it relieve Contractor from sole responsibility for any errors in the updated Contract Schedules.
- F. Contractor shall perform the Work in accordance with the updated Contract Schedule. Contractor may change the Contract Schedule to modify the order or method of accomplishing the Work only with prior agreement by the University.
- G. With each monthly updated Contract Schedule, the Contractor shall provide an accompanying narrative describing the progress anticipated during the upcoming month, critical activities, delays encountered during the prior month, delays anticipated during the upcoming month, and an audit of the Contract Time. The audit shall show current days allowed by contract, days used through the end of the month, days remaining, percent of time used to date, and percent complete as measured by cost loaded schedule, and days ahead of or behind schedule. In the event that the Contractor was delayed by any occurrence during the prior month, the narrative report shall include a listing of all delays that affected the critical path and shall clearly explain the impact the claimed delay(s) had on the critical path and shall include an accounting of days lost or gained.
- H. In the event the monthly update shows the **Contractor** to be behind schedule (negative float), the narrative shall include a description of actions needed to bring the project back on schedule.

3.05 LOOK AHEAD SCHEDULES

- A. Look Ahead Schedule is a schedule derived from the Contract Schedule (or the most current monthly update of the Contract Schedule) which indicates in detail all activities scheduled or worked on for the 1 prior weeks, and all activities scheduled to occur during the next 3 weeks.
- B. Provide detailed Look Ahead Schedules every week.
- C. Submit in 11-inch by 17-inch Gantt chart format.

- D. Look Ahead Schedule shall be generated from the then current Preliminary Contract Schedule, Contract Schedule, or updated Contract Schedule. Activities listed in the Look Ahead Schedule shall reference the activity identification or other such coding for correlation to the activities listed in the Contract Schedule.

3.06 TIME EXTENSION REQUEST DOCUMENTATION

- A. In the event the **Contractor** request an extension of Contract Time, Contractor shall comply with the requirements of the General Conditions, including without limitation, General Conditions Article 8. In addition to the requirements of the General Conditions, as a condition to obtaining an extension of the Contract Time, Contractor shall timely submit a sub-network of the events of the delay that demonstrates the impact to the activities in the Contractor's then current schedule, as well as the impact to the overall completion date of the project.
- B. If the University's Representative approves the extension of time, the next monthly updated Contract Schedule shall incorporate the subnetwork with the extension of time. In addition, the monthly updated Contract Schedule shall contain all changes mutually agreed upon by the Contractor and the University during preceding periodic reviews and all changes resulting from Change Orders and Field Orders.

3.07 AS BUILT SCHEDULE

- A. As a condition precedent to the release of retention, the last update of the Contract Schedule submitted shall be identified by the Contractor as the "As Built Schedule". The "As Built Schedule" shall be submitted when all activities are 100 percent complete. The "As Built Schedule" shall reflect the exact manner in which the project was actually constructed (including start and completion dates, activities, sequences, and logic) and shall include a statement signed by the Contractor's scheduler that the "As Built Schedule" accurately reflects the actual sequence and timing of the construction of the project.

3.08 WEATHER DAYS ALLOWANCE

- A. Should inclement weather conditions, or the conditions resulting from weather, prevent the Contractor from proceeding with seventy-five (75) percent of the normal labor and equipment force engaged in the current critical activity item(s), (as shown on the latest CPM Progress Schedule accepted by the University's Representative), for a period of at least five (5) hours per day toward completion of such operation or operations, and the crew is dismissed as a result thereof, it shall be a weather delay day.

- B. The expected loss of days specified in the Supplementary Conditions, item 3 "Modification of General Conditions, Article 8 – Contract Time", shall be included in a separate identifiable critical activity labeled "Weather Days Allowance" to be included as the last critical activity of the project schedule prior to substantial or final completion (whichever is contractual). The weather allowance activity shall be on, and remain on, the critical path of the project throughout the life of the project until it has been absorbed. Typically, all activity's leading to completion shall go through the weather allowance activity first. When weather days are experienced, and are approved as such by the University's Representative, the Contractor shall either:
1. Increase the duration of the current critical activity(ies) by the number of weather days experienced, or
 2. Add a critical activity to the schedule to reflect the occurrence of the weather day(s).
- C. The duration of the weather day allowance activity shall be reduced as weather days are experienced and included in the schedule. Any remaining weather days in the weather day allowance activity at the completion of the project shall be considered as float and shall not be for the exclusive use or benefit of either the University or Contractor.
- D. The Contractor shall not receive any additional compensation for unavoidable delays due to inclement or unsuitable weather. If all the weather allowance has been used, any additional weather delay experienced by the Contractor may result in a non-compensable time extension upon submission of acceptable supporting documentation to the University's Representative.

END OF SECTION 01 32 00

SECTION 01 32 20

CONSTRUCTION PROGRESS REPORTING

PART I - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Requirements and procedures for documentation of construction progress using still photographs and videos.

B. Related sections include the following:

1. Division 01, Section "Closeout Procedures" for general closeout procedures.
2. Division 01, Section "Closeout Submittals."

1.02 PROGRESS PHOTOS/VIDEOS

A. Maintain a weekly photographic record of the progress of the Work as outlined in Part III of this Section.

1. Photographs to accompany Superintendent Daily Reports will be done on a daily basis.

1.03 AS-BUILT DOCUMENTATION

A. The Contractor shall be responsible for the maintenance and completion of As-Built PDF Drawings and Models the following procedure shall be strictly adhered to:

1. Contractor shall download and save all of the construction documents. This set of Drawings along with the Specifications, shall be kept on file available to University's Representative's until the completion of the Project.
2. As the Work progresses, a complete and accurate notation of all documented changes or deviations from the Drawings and Specifications shall be recorded thereon and in the record model by the Contractor. Such indications shall be neatly made and kept current. Where exact locations are critical, such as in the case of buried piping or conduit, such locations - both horizontal and vertical - shall be dimensioned back to an above ground, permanent fixed point.
3. Properly note construction deviations or changes on the monthly As-Built, prior to proceeding with any Work in those locations. Do not complete Work or request inspections if such Work has been installed in locations contrary to the Drawings.
4. University's Representative may request to review the As-Built, on a monthly basis and prior to each Application for Payment. If requested by University's Representative, provide access to the following:

- a. Approval of Application for Payment is contingent upon timely review of monthly changes on As-Built Drawings and Record Models.
 - b. PDF drawings and The Record Model must be available for review to the University's Representative of the sheets or areas on which changes have been noted during the preceding month.
- 5. All As-Built and Record indications shall be clear and legible.
 - 6. At the completion of the Project, Refer to Section 017800 CLOSE OUT SUBMITTALS.

PART II - PRODUCTS – Not applicable to this section.

PART III - EXECUTION

- 3.01 Contractor is required to maintain a weekly digital photographic record of the progress of the Work and is to submit the photographs and video coverage as required to the University Representative. Daily Photographs are required for Superintendent Daily Reports.

END OF SECTION 01 32 20

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 submittals
- B. University's and University's Consultant's review of submittals
- C. Contractor's review of submittals
- D. Shop Drawing Submittals
- E. Product Data submittals
- F. Sample submittals
- G. Field Samples and mock-ups
- H. Submittal Schedule requirements

1.02 RELATED SECTIONS

- A. Section 011100 – SUMMARY OF THE WORK: Subcontractor and materials suppliers list.
- B. Section 013200 – CONTRACT SCHEDULES: Submission and review of schedules and submittals.
- C. Section 014500 – QUALITY CONTROL: Test and Inspection Reports.
- D. Section 016100 - PRODUCT REQUIREMENTS
- E. Section 017700 – CLOSEOUT PROCEDURES: Occupancy/Acceptance /Final Payment Submittals.
- F. Section 017800 – 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 twenty-one (21) days from receipt to review all submittals twenty-one (21) days from receipt to review re-submittals.
 - 2) The Fire Marshal shall have twenty-eight (28) days from receipt to review all submittals twenty-eight (28) days from receipt to review re-submittals.
 - 3) University's Representative will prepare and keep a log of review time of all submittals.
- 3. Substitutions shall be submitted in accordance with Section 016100 – 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 the University's Project Name and the University's Project 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 Submittals: Submit PDF electronic file with booked marked table of contents and/or sheet index. Submittals for the Fire Department require an electronic file and two (2) hard copies.
 2. Initial/Re-submitted Shop Drawing Review(s): Submit PDF electronic file with booked marked table of contents and/or sheet index. Submittals for the Fire Department require an electronic file and two (2) hard copies.
 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 PDF electronic file with booked marked table of contents and/or sheet index. Submittals for the Fire Department require an electronic file and two (2) hard copies. Contractor is responsible for providing all approved shop drawings for its use and use by subcontractors and/or suppliers.
 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. 092500 – 1 First submittal for Section 092500 – Gypsum Board
 2. 092500 – 2 Second submittal for Section 092500 – Gypsum Board
 3. 092500 – 2A Re-submittal of second submittal for Section 092500 – Gypsum Board
 4. 092500 – 2B Second re-submittal of second submittal for Section 092500 – 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. As-built 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)

- A. Erect at the project site, at a location directed by University's Representative, mock-ups to a size as specified.
1. The following mock-ups are required for this project:
 2. NOT USED
- B. Fabricate each Sample and mock-up to be complete and fully furnished. Unless otherwise agreed, full-size complete samples will be returned and may be incorporated into field mock-ups and Work.
- C. Mock-ups shall be removed by the Contractor at conclusion of the Work at no additional cost to the University.

1.07 SUBMITTAL SCHEDULE

- A. Submittals Schedule: refer to Section 013200 – 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 PDF electronic file with booked marked table of contents and/or sheet index of the Submittal Schedule after it is completed and each time it is update by 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.

1.08 ENVIRONMENTAL PRODUCT DECLARATIONS

- A. Contractor must comply with Buy Clean California Act requirements per California Public Contract Code, Sections 3500-3505.
- B. Contractor shall submit to Project Manager/Construction Manager current facility-specific Environmental Product Declaration for each eligible material proposed to be used on the Project.
- C. Environmental Product Declaration (EPD): Type III environmental impact label, as defined by the International Organization for Standardization (ISO) standard 14025, or similarly robust life cycle assessment methods that have uniform standards in data collection consistent with ISO standard 14025, industry acceptance, and integrity.
- D. Eligible Materials: Any of the following:
 - 1. Carbon steel rebar.
 - 2. Flat glass.
 - 3. Mineral wool board insulation.
 - 4. Structural steel.
- E. Eligible Materials installed on the Project by Contractor must comply with any standards to the extent established in the BCCA or by University, whichever is more stringent. The facility-specific global warming potential for any Eligible Materials must not exceed any existing maximum acceptable global warming potential for that material pursuant to the BCCA or by University, whichever is more stringent ("EM Standards"). The standards are published on the Department of General Services (DGS) website and updated information can be found on this link: <https://www.dgs.ca.gov/PD/Resources/Page-Content/Procurement-Division-Resources-List-Folder/Buy-Clean-California-Act>
- F. Contractor shall not install any eligible materials on the project before submitting a facility-specific Environmental Product Declaration for that material.
- G. This section shall not apply to an eligible material for a particular contract if the University determines, upon written justification published on its Internet website, that requiring those eligible materials to comply would be technically infeasible, would result in a significant increase in the project cost or a significant delay in completion, or would result in only one source or manufacturer being able to provide the type of material needed by the state.

PART II - PRODUCTS – Not Applicable to this Section

PART III - EXECUTION – Not Applicable to this Section

END OF SECTION 01 33 00

SECTION 01 34 00

CONTRACTOR(S) EMERGENCY PROCEDURES

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 UC Davis Health.
- 1.02 This procedure applies to all Contractors and their subcontractors who have contractual agreements with UC Davis Health.

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 has occurred, and University operations will be opening the Hospital Command Center and shifting to emergency operations.
- 2.03 Code Red – Fire
- 2.04 Code White – Hazardous Material / Chemical Spill
- 2.05 Control Facility – the County of Sacramento has designated UC Davis Health as the Control Facility for Sacramento County. The Control Facility coordinates medical control of patients and victim's dispersal to hospitals in the community/region.
- 2.06 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 Health 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 Sacramento campus are as follows.

1. Emergency Telephone Numbers

a.	Police Dispatch:	916-734-2555
b.	PO&M Dispatch (Electrical)	916-734-2763
c.	PG&E (Gas)	800-743-5000
d.	City of Sacramento Water	3-1-1
e.	HazMat Spill	916-734-2740

END OF SECTION 01 34 00

SECTION 01 35 00

SPECIAL PROCEDURES

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 011100 – SUMMARY OF THE WORK
- C. Section 013100 – COORDINATION
- D. Section 013200 – CONTRACT SCHEDULES
- E. Section 015600 – TEMPORARY BARRIERS, ENCLOSURES AND CONTROLS
- F. Section 015610 – AIRBORNE CONTAMINANTS CONTROL
- G. Section 017300 – CUTTING AND PATCHING
- H. Section 017400 – 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) calendar 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 calendar 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 calendar 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 example #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.

2. ILSM example #2: Maintain free and unobstructed access to emergency departments/services.
3. ILSM example #3: Ensure fire alarm, detection, and suppression systems are not impaired.
4. ILSM example #4: Ensure temporary construction partitions are smoke tight and built of noncombustible or limit combustible material that will not contribute to the
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.
 2. 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.
- A. 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



UC DAVIS HEALTH
 FIRE MARSHAL'S OFFICE
 4800 2ND AVE., SUITE 1200
 SACRAMENTO, CA 95817
 916-734-3036



FOR INFORMATION ONLY
 IF YOU HAVE A FIRE HAZARD, CALL 911

INTEGRATED LIFE SAFETY MEASURES (ILSM) INITIAL WORK SHEET

This form is completed by the Project Manager or Contractor or Contractor's Representative. Complete the form and submit to the Fire Marshal's Office for an evaluation of the need for an ILSM, Fire Watch, or other safety measure.

Project Title:			
Date of Project(s):		Time of Project(s):	
A/C#		OSHDP #	
Project Description:			

	Yes	No
Project alters or significantly compromises exit access, exiting, or exit discharge building elements If yes, provide a floor plan showing how exiting is affected. Temporary exit and/or evacuation signs may be required.	☐	☐
Compromise of building compartmentation including fire or smoke walls, floor / ceiling assemblies, corridor walls, use area doors, or other defend in place elements If yes, describe in information.	☐	☐
The issue impairs the building fire alarms or sprinkler systems	☐	☐
The activity includes significant ignition sources such as cutting, welding, or other operations using flame or producing sparks	☐	☐
The activity includes large quantities of combustible materials, flammable materials, or generation of large amounts of dust and debris	☐	☐
Access to fire or life safety equipment affected If yes, what systems or equipment (i.e.: fire watch, Fire Inspector, extinguisher, etc.)	☐	☐
Are construction barriers present / required	☐	☐



UC DAVIS HEALTH
FIRE MANAGEMENT OFFICE
4800 2ND AVE., SUITE 1200
SACRAMENTO, CA 95817
916-734-3036

UC Davis Health
Fire Management Office
1000 University Ave., Suite 1200
Sacramento, CA 95817



Documentation ☐ When ILSMs are required, the following documentation must be maintained:

- Training rosters
- Fire drill reports
- Monthly inspection and testing of temporary fire alarm, detection, and suppression systems
- Daily inspection of construction area
- Weekly inspection of buildings, grounds, and equipment with special attention to excavations, construction areas, construction storage, and field offices
- Completed ILSM form at the job site

Notes: Contractor activities that pose an immediate threat to the health and safety of patients, visitors, hospital employees or construction personnel shall be discontinued immediately until the hazards are abated and corrected and the appropriate ILSM(s) are developed.

Requestor's Signature

Date

UCDH Fire Marshal's Office Representative

Date

Information:

[illegible]

SECTION 01 39 00
GREEN BUILDING POLICY IMPLEMENTATION

PART I – GENERAL

1.01 SECTION INCLUDES

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

1.02 RELATED DOCUMENTS AND SECTIONS

- A. Section 015600 – TEMPORARY BARRIERS, ENCLOSURES and CONTROLS
- B. Section 015610 – AIRBORNE CONTAMINANTS CONTROL
- C. Section 016100 – PRODUCT REQUIREMENTS
- D. Section 017400 – CLEANING
- E. Section 017500 – STARTING and ADJUSTING SYSTEMS
- F. Section 017600 – PROTECTING INSTALLED CONSTRUCTION
- G. Section 017700 – CLOSEOUT PROCEDURES
- H. Section 017800 – CLOSEOUT SUBMITTALS
- I. Section 018100 – PLUMBING/HVAC TESTING PROCEDURES
- J. Section 018200 – DEMONSTRATION and TRAINING
- K. Section 027250 – STORM DRAINAGE WATER QUALITY
- L. Section 142400 – HYDRAULIC ELEVATORS
- M. Section 145800 – PNEUMATIC TUBE SYSTEMS
- N. Division 21 – WET SPRINKLER SYSTEMS
- O. Division 22 – PLUMBING WORK
- P. Division 23 – MECHANICAL WORK (All)
- Q. Division 26 – ELECTRICAL WORK (All)
- R. Division 33 – SITE UTILITIES

1.03 FUNDAMENTAL BUILDING SYSTEMS COMMISSIONING

- A. Commissioning is a systematic process of ensuring that all building systems and assemblies perform interactively according to University objectives and requirements and the design according to the contract documents. The commissioning process encompasses and coordinates the traditionally separate functions of system documentation, equipment start-up, control system calibration, systems testing, testing and balancing, and training. The commissioning process does not take away from or reduce the responsibility of the **Contractor** to provide a finished and fully functioning product. Commissioning during construction is intended to achieve the following specific objectives:
1. Ensure that applicable equipment, systems, and assemblies are installed according to the manufacturer's recommendations and to accepted industry standards, and that they receive adequate operational checkout by the **Contractor**.
 2. Ensure and document that equipment, systems, and assemblies' function and perform according to University objectives and requirements and the Contract Documents.
 3. Ensure that operations and maintenance (O&M) manuals are complete.
 4. Ensure that University operating and maintenance personnel for all systems are adequately trained.
- B. Commissioning will be performed under the authority and management of the University Plant Operations & Maintenance Department (PO&M), as an independent organization whose individuals are not directly responsible for project design or construction management.
- C. **Contractor** Commissioning Responsibilities
1. Designate a Commissioning Coordinator to organize, schedule, and coordinate the execution of **Contractor** and subcontractor commissioning responsibilities.
 2. Ensure that commissioning activities and durations including predecessors' activities completed prior to the start of commissioning activities, are represented in the contract schedule.
 3. Notify the University when system testing for mechanical and electrical items, installations, and equipment per mechanical and electrical specifications will be conducted.
 4. Provide all labor, materials, and subcontractor support required for system testing and commissioning to the University.
 5. Attend and participate in commissioning planning and other associated meetings to facilitate the commissioning process.
 6. Provide additional documentation prior to normal O&M manual submittals to the University for development of installation, start-up, and testing procedures.

7. Assist in clarifying the operation and control of commissioned equipment or assemblies in areas where the specifications, control drawings, or equipment documentation is not sufficient preparing testing procedures.
8. Review test procedures developed by the University to ensure feasibility, safety, and equipment protection.
9. Verify that all equipment to be tested or commissioned is installed correctly, anchored correctly, electrical, wiring & breakers are the correct size for the equipment and all other utilities required are installed.
10. Execute testing for selected systems and assemblies under the direction of the University.
11. For work that did not pass testing or commissioning evaluate, identify, make repairs or corrections so not to delay the testing or commissioning process. Update the schedules with the revised commission activities.
12. Ensure that the local authorities having jurisdiction are present to witness any acceptance testing of systems that are a condition of building occupancy (fire alarm, fire damper, sprinkler system, etc.).
13. Train University personnel and prepare O&M manuals in accordance with the Contract Documents.

1.04 CONSTRUCTION WASTE MANAGEMENT: DIVERT 80% FROM LANDFILL

- A. Landfill Diversion Requirement: Divert 80% minimum of total project waste from landfill.
- B. Storage bins
- C. Submittals
 1. Waste Management Plan (WMP): Provide the following information:
 - a. Waste Material Estimating Sheet (Appendix A at the end of this Section): Project title, name of company which will implement the plan, and date.
 - b. Estimated job site waste to be generated, including types and quantities.
 - c. Proposed Alternatives to Landfilling: List each material planned to be salvaged or recycled, including quantities and proposed destination.

2. Waste Management Progress Reports: Submit the following information to the University's Sustainability Administrator on a monthly basis (for example: information for June is due by July 20):
 - a. Waste Management Log (Appendix B at the end of this Section):
 - b. Project title, name of company completing report and dates of period covered by the report.
 - c. Date, destination, and quantity of each type of material landfilled, salvaged or recycled.
 - d. Weighmaster tickets can be substituted for items a and c (except for salvaged items). In all instances, weighmaster tickets must be provided with this submittal.
 - e. Alternative report formats may be acceptable but must be reviewed and approved by the University's Sustainability Administrator before being used in lieu of the requirements above.
3. Legible copies of manifests, weight tickets, and receipts. Manifests shall be from recycling and/or disposal site operators that can legally accept the materials for the purpose of reuse, recycling or disposal.
4. Maintain at the Project site Waste Management Logs for each load of materials removed from site.

D. PROJECT MEETINGS

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

E. PROJECT CONDITIONS

1. Hazardous materials are excluded from the work of this Section. If hazardous materials are encountered or suspected, stop work in the suspect area. Refer to Section 013500 Special Procedures.

F. CONSTRUCTION WASTE RECYCLING SERVICES

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

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

1. Concrete: Clean concrete, concrete with rebar, asphalt concrete.
2. Metals: Steel, iron, galvanized sheet steel, stainless steel, aluminum, copper, zinc, lead, brass or bronze, including banding, ductwork, framing, roofing and siding, flashing, piping and rebar.

3. Aggregate.
4. Wood: Clean dimensional wood, wood pallets, engineered wood products including plywood, particleboard, I joists.
5. Vegetation.
6. Cardboard, paper, packaging.
7. Masonry: Brick, ceramic tile, CMU.
8. Gypsum board.
9. Acoustic ceiling panels.
10. Carpet and pad.
11. Paint.
12. Insulation.
13. Plastics: ABS, PVC
14. Beverage containers

H. WASTE MANAGEMENT PLAN IMPLEMENTATION

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

1.05 CONSTRUCTION INDOOR AIR QUALITY (IAQ) MANAGEMENT PLAN: DURING CONSTRUCTION

- A. Develop and implement an Indoor Air Quality (IAQ) Management Plan for the construction and pre-occupancy phases of the building including:
1. Meet or exceed the recommended design guidelines of the Sheet Metal and Air Conditioning National Contractors Association (SMACNA) IAQ Guidelines, 1995, Chapter 3. Compliance with SMACNA Guidelines shall start no later than the scheduled HVAC startup date. SMACNA Guidelines for HVAC protection and for protection of absorptive materials may need to start at an earlier stage, in accordance with the construction schedule.
 2. Protect stored on-site or installed absorptive materials from moisture damage.
 3. Comply with requirements in Division 23 for Ductwork.

- B. Develop and implement an Indoor Air Quality Management Plan for the pre-occupancy phase.
 - 1. Comply with requirements of in Division 23 for Ductwork.
- C. Submittals
 - 1. Construction Indoor Air Quality Management Plan.
 - a. Submit documentation demonstrating that an Indoor Air Quality Management Plan was developed and implemented, including:
 - 2. SMACNA IAQ Guidelines Chapter 3 implementation.
 - 3. Stored on-site or installed abortive materials were successfully protected from moisture damage.
 - 4. Maintaining ductwork internal cleanliness.
 - 5. Documentation including product data, that if any air handling systems were used during construction, that any return and exhaust grilles were protected with filtration media with a Minimum Efficiency Reporting Value (MERV) of at least 13 (per ASHRAE 52.2) including filtration media manufacturer's name, model number, and MERV value.
 - 6. Documentation, including product data, that all filtration media was replaced prior to occupancy with filtration media with a Minimum Efficiency Reporting Value (MERV) of at least 13 (per ASHRAE 52.2) including filtration media manufacture's name, model number, and MERV Value.
 - 7. Provide photographs verifying plan compliance at different phases of construction.
 - 8. Submit documentation that a minimum two weeks building 100% outside air flush-out was completed, including dates when the flush-out was begun and completed and what steps were taken to guarantee 100% outside air usage.
 - 9. Submit documentation for the filtration media used during the flush-out period, including filtration media manufacturer's name, model number, and MERV value.
- D. Implementation
 - 1. HVAC Protection
 - a. Comply with Section in Division 23 for Ductwork

2. Source Control

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

3. Housekeeping

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

4. Scheduling

- a. When possible, install carpets, furnishings and highly absorbent materials after all VOC-emitting products have been installed and fully cured.
- b. Provide sufficient ventilation and air circulation after VOC-emitting materials are installed.
- c. New MERV 13 filters shall be installed immediately following the flush and prior to building occupation. Refer to Division 23 – Ductwork for additional requirements. Monitoring of IAQ Plan

- d. A minimum of 18 photographs, documenting the progress of the IAQ management Plan implementation, shall be taken at the following stages:
 - 1) Site delivery and storage processes
 - 2) Installation, protection, and housekeeping activities
 - 3) Commissioning, flushing, and re-filtering of HVAC systems

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

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

5. Building Flush-Out

- a. Building flush-out and report: The subcontractor shall conduct a building flush-out and prepare a flush-out report. The flush-out report should include:
 - 1) Total days required, and actual days conducted.
 - 2) Hours per day required actual hours conducted.
 - 3) Outside air percentage recommended and actual used.

PART II – PRODUCTS – Not Applicable to this section

PART III – EXECUTION

3.01 Refer to the following attachments

- A. Appendix A: Waste Materials Estimating
- B. Appendix B: Waste Management Log"

END OF SECTION 01 39 00

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

PROJECT TITLE: _____

COMPANY: _____

DATE: _____

		TOTAL AMOUNT GENERATED	AMOUNT RECYCLED	AMOUNT SALVAGED	AMOUNT LANDFILLED
MATERIAL	DESTINATION	TONS	TONS	TONS	TONS
TOTALS					

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

PROJECT TITLE: _____

COMPANY: _____

LOG DATES: _____ through _____

Date	Material	Destination	Tons			
			Salvaged	Recycled	Landfilled	Total
Totals						

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

SECTION 01 41 00**REGULATORY REQUIREMENTS****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. California State Fire Marshal Requirements
- E. Department of Health Care Access and Information Projects

1.02 RELATED SECTIONS

- A. Section 013500 – SPECIAL PROCEDURES
- B. Section 014200 – REFERENCES
- C. Section 014500 – 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 than required by applicable codes, ordinances and standards, the Contract Drawings and Contract Specifications shall take precedence so long as such increase is legal.
 - 3. Where no requirements are identified in Contract Documents, comply with all requirements of applicable codes, ordinances and standards of governing authorities having jurisdiction.

1.04 APPLICABLE CODES, LAWS AND ORDINANCES

A. Building Codes, Laws, and Regulations:

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

a. California Code Series - 2019 Edition

- 1) California Administrative Code, California Code of Regulations – Title 24, Part 1
- 2) California Building Code, California Code of Regulations – Title 24, Part 2, Volume 1& 2
- 3) California Electrical Code, California Code of Regulations – Title 24, Part 3
- 4) California Mechanical Code, California Code of Regulations – Title 24, Part 4
- 5) California Plumbing Code, California Code of Regulations – Title 24, Part 5
- 6) California Energy Code, California Code of Regulations – Title 24, Part 6
- 7) Elevator Safety Construction Code, California Code of Regulations – Title 24, Part 7
- 8) California Historical Building Code, California Code of Regulations – Title 24, Part 8
- 9) California Fire Code, California Code of Regulations – Title 24, Part 9
- 10) California Existing Building Code, California Code of Regulations – Title 24, Part 10
- 11) California Referenced Standards Code, California Code of Regulations – Title 24, Part 12

b. NFPA Code Series. National Fire Protection Association (NFPA) (as adopted by State agencies)

- 1) NFPA 13 – Standard for the Installation of Sprinkler Systems.
- 2) NFPA 14 – Standard for the Installation of Standpipe and Hose System
- 3) NFPA 72 – National Fire Alarm and Signaling Code
- 4) NFPA 80 – Standard for Fire Doors and Other Opening Protectives

- 5) NFPA 99 – Health Care Facilities Code
 - 6) NFPA 101 – Life Safety Code
 - 7) NFPA 252 – Standard Methods of Fire Tests of Door Assemblies
 - 8) NFPA 701 – Standard Methods of Fire Tests of Flame Propagation of Textiles and Films
 - c. California Code of Regulation Series (embodied in California model codes as noted above)
 - 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
 - d. Americans with Disabilities Act (ADA) 2010 (Federal Law)
 - e. Rules and regulations of private and public utilities
 - f. American National Standards Institute (ANSI)
 - g. American Society of Testing Materials (ASTM)
 - h. Federal Specifications (Fed. Spec.)
 - i. Underwriters Laboratories
 - j. Traffic controls per California MUTCD requirements
- 2. All dates to comply with editions adopted and 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 contractor's license appropriate for the work performed. Otherwise, specialty contractors shall be retained by the Contractor to perform specialty work identified in the project scope.

1.05 PROJECT INSPECTIONS

- A. Provision of inspectors by University, if any, or by Department of Health Care Access and Information pursuant to this Section and Section 1.04 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 Work shall not relieve Contractor for responsibility to complete Work in accordance with Contract Documents.

1.06 DEPARTMENT OF HEALTH CARE ACCESS AND INFORMATION PROJECTS (If applicable or NOT USED)

- A. Department of Health Care Access and Information (HCAI) is the agency having jurisdiction over all acute care medical project design and construction unless a Memorandum of Understanding (MOU) has been established assigning University staff to perform regulatory duties.
- B. HCAI will approve an inspector for the Project who shall have full access to the Project at all times.
- C. HCAI 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. HCAI will require a Building Permit for project submitted by University's Representative. No HCAI Building Permit fees are required to be paid by the Contractor.
- E. HCAI will require Change Order Approval submitted by University's Representative.
- F. HCAI will require a Licensed Contractor's Declaration from the Contractor.
- G. HCAI projects shall comply with the 2016 California Administration Code.

1.07 DEFERRED APPROVAL

- A. Where noted in the Contract Documents, certain items of materials and/or systems may require HCAI/CSFM 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

SECTION 01 42 00

REFERENCES

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 014100 – 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 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. Construction Site: Same as site.

7. 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.
8. Equal or Equivalent: As determined by the University's Consultant as being of the same quality, appearance, utility, durability, finish, function, suitability, and performance.
9. Furnish: Means "supply and deliver, ready for unloading, unpacking, assembly, installation, and similar operations".
10. 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.
11. Install: Describes operations at the site including unloading, unpacking, assembly, erection, anchoring, applying, working to dimension, protecting, cleaning, and similar operations.
12. 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. Jobsite: Same as site.
14. 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.

15. Noted: Same as indicated.
16. Owner-Furnished/Contractor-Installed (UFCI): Item, system or equipment furnished by University at its cost and installed by the Contractor as part of the Work.
17. Per: In accordance with or in compliance with.
18. Products: Materials, systems or equipment.
19. Project site: Same as site.
20. 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.
21. Provide: Means "furnish and install, complete and ready for use".
22. 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.
23. 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.
24. Scheduled: Same as indicated.
25. 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.
26. Shown: Same as indicated.
27. 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.

28. Testing Laboratories: Same as Testing and Inspection Agency.
29. 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.
30. University-Furnished/Contractor-Installed (UFCI): 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:

AA	Aluminum Association
AAA	American Arbitration Association
AAC	Architectural Anodizers Council
AABC	Associated Air Balance Council
AAMA	American Architectural Manufacturers Association
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
ACPA	American Concrete Pipe Association
ACPA	American Concrete Pumping Association
ADA	Americans with Disabilities Act
ADC	Air Diffusion Council
AFSA	American Fire Sprinkler Association
AGA	American Galvanizers Association (formerly AHDGA)
AGA	American Gas Association
AGC	Associated General Contractors of American
AI	Asphalt Institute
AIA	American Institute of Architects
AIMA	Acoustical and Insulation Materials Association
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AMCA	Air Movement and Control Association International
ANSI	American National Standards Institute
APA	Engineered Wood Association (formerly American Plywood Association)
APWA	American Public Works Association
ARMA	Asphalt Roofing Manufacturers Association
ASAC	American Subcontractors Association of America
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
ASLA	American Society of Landscape Architects
ASME	American Society of Mechanical Engineers
ASNT	American Society for Nondestructive Testing
ASPE	American Society of Plumbing Engineers
ASTM	American Society for Testing and Materials
AWI	Architectural Woodwork Institute
AWPA	American Wood Preservers' Association
AWS	American Welding Society
AWWA	American Water Works Association
BHMA	Builders Hardware Manufacturers Association
BOC	Board of Corrections
CABO	Council of American Building Officials
CAC	California Administrative Code (see California Code of Regulations (CCR))
CAL/OSHA	State of California Construction Safety Orders
CBC	California Building Code
CCR	California Code of Regulations
CEC	California Electrical Code
CFC	California Fire Code
CFR	Code of Federal Regulations
CIMA	Construction Industry Manufacturers Association
CISPI	Cast Iron Soil Pipe Institute
CLFMI	Chain Link Fence Manufacturers' Institute
CMC	California Mechanical Code

CPC	California Plumbing Code
CRSI	Concrete Reinforcing Steel Institute
CSI	Construction Specifications Institute
CTIOA	Ceramic Tile Institute of America, Inc.
DHI	Door and Hardware Institute
DSA	Division of the State Architect
EJMA	Expansion Joint Manufacturers Association
FGMA	Flat Glass Marketing Association
FM	Factory Mutual Research Organization
FS	Federal Specification (from GSA)
GA	Gypsum Association
GSA	General Services Administration
HCAI	Department of Health Care Access and Information (State of California)
IAPMO	International Association of Plumbing and Mechanical Officials
IEEE	Institute of Electrical and Electronics Engineers, Inc.
ISO	International Organization for Standardization
MIA	Masonry Institute of America
ML/SFA	Metal Lath/Steel Framing Association
MM	State of California, Business and Transportation Agency, Department of Transportation, "Materials Manual"
MSS	Manufacturers Standardization Society of the Valve and Fittings Industry
NAAMM	National Association of Architectural Metal Manufacturers
NEC	National Electrical Code
NECA	National Electrical Contractors Association
NEMA	National Electrical Manufacturers Association
NFC	National Fire Code
NFPA	National Fire Protection Association
NFSA	National Fire Sprinkler Association
NGA	National Glass Association
NIBS	National Institute of Building Sciences
NIST	National Institute of Standards and Technology
NPCA	National Precast Concrete Association
NRCA	National Roofing Contractors Association
NSC	National Safety Council
NSF	National Sanitation Foundation
NSPE	National Society of Professional Engineers
NTMA	National Terrazzo and Mosaic Association
NWMA	National Woodwork Manufacturers Association
OSHA	Occupational Safety and Health Administration
PCA	Portland Cement Association
PCI	Precast/Prestressed Concrete Institute
PDCA	Painting and Decorating Contractors of America
PDI	Plumbing and Drainage Institute
PS	Product Standard (U.S. Department of Commerce)
RIS	Redwood Inspection Service
SDI	Steel Deck Institute
SFM	State Fire Marshal (California)
SFPE	Society of Fire Protection Engineers
SGCC	Safety Glazing Certification Council
SIGMA	Sealed Insulating Glass Manufacturers Association
SJI	Steel Joist Institute
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
SSPC	Society for Protective Coatings (Steel Structure Painting Council)
SSPWC	Standard Specifications for Public Works Construction
SWRI	Sealant, Waterproofing and Restoration Institute
TCA	Tile Council of America
TJC	The Joint Commission
UBC	Uniform Building Code
UFC	Uniform Fire Code
UL	Underwriters Laboratories, Inc.
UMC	Uniform Mechanical Code
UPC	Uniform Plumbing Code
USS	United States Standard
WCLIB	West Coast Lumber Inspection Bureau
WIC	Woodwork Institute of California
WWPA	Western Wood Products Association

- D. Words and terms not otherwise specifically defined in this Section or in the Contract Documents, shall be as customarily defined by trade or industry practice, by reference

standard and by specialty dictionaries such as Dictionary of Architecture and Construction (Cyril M. Harris, McGraw-Hill Educational; 4th Edition, September 5, 2005).

- 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

SECTION 01 45 00

QUALITY CONTROL

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's responsibilities in inspections and tests
- H. Contractor's responsibilities regarding the University's testing laboratory
- I. Test reports
- J. Geotechnical engineer

1.02 RELATED SECTIONS

- A. Section 013100 – COORDINATION
- B. Section 014100 – REGULATORY REQUIREMENTS: Compliance with applicable codes, ordinances and standards.
- C. Section 014550 – INSPECTION and TESTING of WORK
- D. Section 016100 – PRODUCT REQUIREMENTS: Product Options, substitutions, transportation and handling requirements, storage and protection requirements, and system completeness requirements.

1.03 [CONTRACTOR'S] [CM/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 required by contract or necessary if not prescribed 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 and adjacent construction.
- 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 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 Marshal's office 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. Manufacturer's Representatives shall provide a PDF electronic report indicating but not limited to work or materials that are missing, not installed correctly, damaged or need correction. Manufacturer's Representatives shall issue a final PDF electronic report once all work and materials are installed correctly, functioning and in compliance with the Manufacturer's Warranty.

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.

- E. Changes in mix designs for concrete and mortar after review and acceptance of submitted mix design. Test and inspections shall include, but not be limited to, the following:

List the applicable services required, for example:

Material Inspections and Tests		Paid by:
Concrete Reinforcement	Reinforcement Inspection	University
	Reinforcement Strength	University
Cast in Place	Slump Tests	University
	Compressive Strength Tests	University
Structural Steel	Welding Inspection	University
	High Strength Bolting Inspection	University

- F. Test and Inspection Reports: After each inspection and test, one (1) PDF electronic 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 Project 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 014550 – INSPECTION and TESTING 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 UNIVERSITY 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) PDF electronic copy of all reports to the University's Representative, indicating observations and results of tests and indicating compliance or non-compliance with Contract Documents.

1.12 University will distribute one (1) PDF electronic copy of the reports to University's Consultants and Contractor, GEOTECHNICAL ENGINEER (If applicable or NOT USED)

- 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

SECTION 01 45 10

SEISMIC CONTROL – HCAI

PART I - GENERAL

1.01 DESCRIPTION

- A. Provide all required seismic restraints and calculations to ensure 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
- B. 2019 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 including shop drawing and other documentation to comply to the requirement of this Section.
- B. Submit special seismic certification (OSP) for mechanical and electrical equipment/components as noted on CBC 1705A.13.3.1 Contractor shall bear all costs associated with all tests, engineering calculations and documentation required to obtain Department of Health Care Access and Information (HCAI) 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 HCAI Pre-approved Manufacturer's Certification (OPM) as noted on the design drawings with only one applicable OPM per application.

PART II - PRODUCTS

2.01 SEISMIC RESTRAINT REQUIREMENTS

A. SUMMARY

- 1. This section covers the seismic restraint requirements for suspended distribution systems, vibration and non-vibration isolated items, systems and/or related suspended equipment.
- 2. The designers of record (DOR) as referenced in this specification shall be the project architect, structural engineer, and the appropriate system engineer (e.g., electrical, etc.).

3. An HCAI OPM determined by the DOR shall be considered as the specified seismic design for this project. Other non-OPM designs may be submitted as an alternate if they meet or exceed all the requirements contained within these specifications, HCAI pre-approved service loads, installation applications, and engineering services.
4. Channel framing materials, fittings and related accessories shall be as indicated on the OPM and on the drawings. All channel members (trapezes and braces) shall be solid strut. Field drill bolt holes at 1/16" larger than bolt size as required for connections. Back-to-back struts shall be stitch groove welded or button welded.
5. To facilitate plan review and construction, all construction documents should include an equipment schedule identifying all applicable equipment, its classification (fixed, movable, mobile, other, countertop, interim or temporary) and reference to support and attachment per Pin 68-Table 1.

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, fire sprinkler and architectural.
 - b. Without referencing OPM or HCAI pre-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 performed (signed & sealed) by a licensed California Structural Engineer and submitted to the DOR and HCAI 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 7-16-13.3.2.
 - d. Pipes with hazardous contents including but not limited to medical gas, fuel oil, natural gas piping, etc., regardless of size and weight shall be seismically braced per the OPM or HCAI pre-approved design.
 - e. Support and attachment requirements for fixed, interim, mobile, movable, other, and temporary equipment shall be in accordance with HCAI PIN 68.
2. Seismic restraint transverse and/or longitudinal spacing shall be in accordance with CBC and OPM and limited to the following:
 - a. Seismic design forces equal to or less than the capacity of the building structure.
 - b. 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).
 - c. 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).

- d. 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. All submittals for omission of seismic restraints must include the following and must be performed (signed & sealed) by a licensed California Structural Engineer and approved by HCAI.
 - a. Project specific cover letter clearly indicating that said engineer has completely reviewed the project documents, and that the items/systems were designed individually and in coordination with all other trades and references the code section(s) where the omission of seismic restraints is allowed.
 - b. Lateral motion of the supported items/systems shall not directly or indirectly impact adjacent 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 unless referenced in the OPM document.
6. Ceiling system shall not be used as a seismic restraint, sway brace and/or safety restraint material.
7. Non-seismic and/or safety restraints sway bracing shall meet or exceed that required for the attachment of seismic restraints to the building structure.
8. Seismic restraints shall be installed to provide a minimum of (2) two transverse and (1) one set of (2) two longitudinal braces per run and per the OPM document.
9. The accumulated load of multiple items at any given support (with or without seismic restraints) shall not overload the building structure and the support assembly.
10. Pipes, conduits, and other items attached to trapeze hangers shall be located uniformly along each individual trapeze hanger so that the accumulated load is evenly distributed.
11. Trapeze systems installed in a multi-layer configuration shall have seismic restraints designed and installed for each individual trapeze layer.
12. 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.
13. SMACNA details shall not be used without prior approval by Structural Engineer of Record (SEOR).

C. ACCEPTABLE MANUFACTURERS

1. HCAI 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 one of the following:
 - a. ICC evaluation report
 - b. HCAI pre-approval
3. 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.
4. Cast-in-place inserts that allow for horizontal adjustment shall not be allowed unless an engineered solution is provided to assure positive captured positioning and secured attachment.
5. 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 scanning of the slab and wall for clearances, and to prevent damages to embedded electrical conduits and/or mechanical piping and reinforcing steel.
6. 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. 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. Special inspection for special seismic certification per CBC 1705A.12.4.

PART III - 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.
- C. Lighting fixture supports:
 - 1. Provide independent seismic support system per CBC.
- 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.
 - 2. Except for sprinklers installed using flexible sprinkler hose, installed clearance shall be 3 inches between any sprinkler drop or sprig and permanently attached equipment and other distribution systems, including their structural supports and bracing.

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 1910A.5.
- 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 and as noted on the drawings.
- F. All testing procedures shall be in accordance with CBC 1910A.5, and as noted on the drawings.
- G. Locate existing reinforcing steel and conduits in slabs and walls prior to drilling holes for the mechanical anchors.

END OF SECTION 01 45 10

SECTION 01 45 50

INSPECTION AND TESTING OF WORK

PART I - GENERAL

1.01 SECTION INCLUDES

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

1.02 RELATED SECTIONS

- A. Section 013100 – COORDINATION
- B. Section 013200 – CONTRACT SCHEDULES
- C. Section 013500 – SPECIAL PROCEDURES
- D. Section 014100 – REGULATORY REQUIREMENTS
- E. Section 014500 – QUALITY CONTROL

1.03 DEFINITIONS

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

1.04 PROJECT INSPECTIONS AND TESTING PROCEDURES

- A. Inspections: This Project (is) (is not) under the jurisdiction of the Department of Health Care Access and Information. The following inspections will be requested on this project, as appropriate. Also see Part 3 for non-HCAI inspection items or Part 3, Item 3.11 for HCAI requirements.
 - 1. Inspections required by the California Building Code
 - 2. Inspections listed on the Testing, Inspection and Observation (TIO) form
 - 3. 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 HCAI/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.
 3. A complete set of codes referred to in the approved plans must be maintained on the job at all times.
 4. Contractor shall submit verified compliance reports as outlined in the California Administrative Code, Section 7-151.

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. HCAI Field Compliance Inspectors: Fourteen (14) calendar days.
 3. Testing Laboratory Inspections: Forty-eight (48) 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. Emailed inspection requests will be accepted. University's Representative email address is lfuka@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 013100 – 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 than 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 \$153.00 per hour during normal work hours and \$229.50 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-HCAI 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 3.11 for Testing, Inspection Observation for HCAI.

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 jobsite 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)

Note: Fire Sprinkler and Fire Alarm systems tests shall be performed in presence of State Fire Marshal.

- A. Approved drawings shall be on jobsite 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.
- C. Emergency Electrical System, Life Safety Branch.
- 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 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).

3.06 KITCHEN HOOD FIRE SUPPRESSION SYSTEM (Title 24, Part 9, Article 10, Section 1005; Part 9, Section 10.513)

- A. Approved drawings shall be on jobsite from start to completion of project.
- B. State Fire Marshal to witness system test.

3.07 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).

3.08 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).
3. Water Heater Temperature Test (Laundry) (169°F).
4. Water Heater Temperature Alarm Test (Patient) (125°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).

3.09 ELECTRICAL CHECKLIST FOR CLOSE-OUT (Title 24, Part 3, and Part 1, Chapter 7, Section 7- 141, 7-149)

A. Main Panel/Service

1. Identification and Labeling of Equipment (110-21, 110-22, 230-70).
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).
2. Identification and Labeling of equipment (110-21, 110-22, 517-22).
3. Lighting and Lighting Levels (517-22).
4. Receptacles (410L, 517-13, 517-18, 517-19).
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.
6. Identification and Labeling of equipment (110-21; 110-22).
7. Identify circuits (Critical Care Areas) (517-19).

D. Miscellaneous Electrical Requirements

1. Test logs from [Contractor][CM/Contractor][Design-Builder] 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 documents to Owner.

3.10 FIRE MARSHAL INSPECTION REQUIREMENTS

A. Framing Inspections

1. Structural members in fire-resistive construction.
2. Check fireproofing per approved design tested assembly description.

B. Fire-Rated Partition Locations

1. Check for stud and nailing/screwing spacing per approved design tested assembly description.
2. Check for fire blocking in combustible construction.
3. Check for rated door/window frame installation (manufacturer's installation instructions shall be available for review).
4. Check for electrical installation, for example, number and size of electrical boxes, panels, cabinets, etc.
5. Check hangers, seismic bracing for sprinkler piping installation, if applicable (this would be checked during overload pressure test inspection phase of sprinkler system).

C. Close-In Inspections

1. Check fire-blocking and draft stops in combustible construction.
2. Check gypsum board installation in accordance with approved design assembly description for rated assembly.
3. Check integrity of firewall construction where recessed cabinets, panels, excessive electrical/plumbing are installed.

4. Check fire damper installation (manufacturer's installation instructions shall be available for review). Fire Marshal will witness actuation of minimum 10% fire dampers installed and 100% in 2 hour or greater fire rated wall assemblies.
5. Check for through-penetrations and fire-stop systems in all walls or floor/ceiling assemblies.
 - a. Check top of wall to structure fire stopping.
6. Check above ceiling areas and construction prior to installation of ceilings.
 - b. Check access and serviceability for above ceiling to included but not limited to valves, mechanical equipment, electrical equipment and other components that require adjustment, access or service.
 - c. [Contractor] [CM/ Contractor] [Design Builder] shall move any items including but not limited to conduit, piping, braces and other obstructions that block access to equipment and components needing adjustment, access or service.
 - d. Check bracing, anchorage, fasteners and installation.

D. Final Construction Inspections

1. Final project walk-through: Example, Emergency lighting will be tested to verify exit illumination of both interior and exterior, while generator (if applicable) is tested at same time.

3.11 HCAI – Testing, Inspection and Observation (TIO)(If applicable or NOT USED)

Note: This item describes the required code related inspection items for HCAI projects. See HCAI approved project TIO.

3.12 Refer to the following attachment

- A. Inspection Request
- B. Non-conforming Work Notice

END OF SECTION 01 45 50

INSPECTION REQUEST

Project #: _____ HCAI #: _____ UCDH IR #: _____ [Contractor][CM/Contractor][Design-Builder] IR #: _____ Date: _____
Project _____ Spec Section _____

Name: _____ (s): _____

To: UC Davis Health Facilities Design & Construction – Inspection Trailer 4430 V Street, Building 35 Sacramento, CA 95817 P: 916-734-5060 Email: lfuka@ucdavis.edu & Project IOR	From: _____ _____ _____ P: _____ E-mail: _____

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.): _____

*Re-inspection Requested for Previous UCDH IR #: _____

All work Requested for Inspection has been reviewed for compliance with the contract documents by [Contractor][CM/Contractor][Design-Builder]'s Superintendent prior to notification of Inspection Request.

Signed: _____ Date: _____

UNIVERSITY USE ONLY

Date Received: _____ Time of Inspection: _____

Date of Inspection: _____ Inspector: _____ ☐ Inspection Report Attached

Inspector Arrival Time: _____ Inspector Departure Time: _____

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

PROJECT #: _____ HCAI #: _____ Notice #: _____ Date: _____

To: <u>Aaron Allen, UCDH PM</u> <u>Taylor Design, DPOR</u> <u>Keith Potter, HCAI ACO</u> _____ _____	From: UC Davis Health IOR Facilities Design & Construction – Inspection Trailer 4430 V Street, Building 35-A Sacramento, CA 95817 P: 916-734-5060

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, ADVISE UNIVERSITY'S REPRESENTATIVE IN ACCORDANCE WITH THE GENERAL CONDITIONS.

Description of corrective action taken: _____

Accepted by: _____ Date: _____

CC:



Testing, Inspection, and Observation Program

2019 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, acute psychiatric hospitals, and general acute care hospitals providing only acute medical rehabilitation center services (2019 CBC 1224.1).

SECTION A		PROJECT INFORMATION	
Facility #:	Facility Name:		Project #:
10619	University of California Davis Medical Center		S221899-34-00
Street Address:	2315 Stockton Boulevard		
City:	Sacramento	County:	Sacramento
Record Name (Scope of Project):		DT1 #1745B CATH LAB Replace X-RAY Equipment	
Abbreviations: CAC: California Administrative Code AAMA: American Architectural Manufacturers Association CBC: California Building Code NFPA: National Fire Protection Association CEC: California Electrical Code FM: FM Approval Standards CMC: California Mechanical Code DPOR: Design Professional of Record CPC: California Plumbing Code			
			Version: R04.25

Testing, Inspection, and Observation Stages

Stage No.	Stage Name	Stage Scope / Description
1	Phase 1	Cath Lab 2 (1745B), Eq. Closet (1745D), and Control Room (1745C)
2	Phase 2	Men's Staff Lockers Room and Restroom (1748)
3	Phase 3	Women's Staff Locker Room and Restroom (1749)
4	Phase 4a	Clean Utility (1747)
5	Phase 4b	Scrub Sink (1745)
6	Phase 5	Lead Vest Storage Closet (1740G)

DESIGN PROFESSIONAL OF RECORD RESPONSIBILITY

The administration of the work of construction, including this TIO, shall be under the responsible charge of an architect and structural engineer. When a structural engineer is not substantially involved, the architect shall be solely responsible. Where neither structural nor architectural elements are substantially involved, a mechanical or electrical engineer registered in the branch of engineering most applicable to the project may be in responsible charge. (CAC 7-141(a))

Note: HCAI plan review staff must provide verification that the TIO program has been "Reviewed" prior to plan approval to confirm the applicability of the tests and inspections identified in the TIO program for work scope, building systems, and the construction materials shown in the design drawings. Field staff will issue subsequent "TIO Program Approval".

The "TIO Program Approval" from HCAI field staff must be obtained and included with the notice of start of construction required by CAC Section 7-137(a)4 and 7-145(a)5.A)



Testing, Inspection, and Observation Program

2019 California Building Standards Code - OSHPD 1

SECTION B			NOTE: Approved agencies, individuals, and all changes to the TIO program shall be identified, evaluated by the DPOR and approved by HCAI prior to proceeding with the related work.				
Facility #:		Facility Name:		Project #:			
10619		University of California Davis Medical Center		S221899-34-00			
Stage 1: Phase 1			Select with "X" or provide required OPAA information:				
Index #	Stage 1 Required (Select with "X")	TESTS	Samples of Test & Inspection Reports Included	OPAA No. and Expiration Date	Responsible Approved Agency And/Or Individual	Compliance Verification by IOR (Initial/Date)	HCAI/FDD Use (Initial/Date)
STRUCTURAL TESTS							
Concrete							
B-C14	X	Post-installed anchors CBC 1910A.5 Installation verification test (includes adhesive, shot pins and mechanical anchors)					
B-C15	X	Existing post-installed anchors CBC 1708A and CAC Chapter 6, Section 11.3 Direct tension test					
Steel							
B-S1	X	Steel CBC 2202A.1 Identification test for structural steel and cold formed steel					
ELECTRICAL TESTS							
B-E1	X	Ground Fault Protection of Equipment CEC 230.95(C) & 517.17(D)					
B-E4	X	Emergency Stored Electrical Energy System Test NFPA 111-2016 Section 7.6					
B-E6	X	Essential Electrical System Coordination Study CEC 517.31(G) & 700.32					
B-E8	X	Grounding System in Patient Care Spaces 2018 NFPA 99 6.3.3.1					
B-E9	X	Hospital Grade Receptacles 2018 NFPA 99 6.3.3.2.5					
B-E10	X	Isolated Power Systems – Line Isolation Monitor Test 2018 NFPA 99 6.3.3.3.2					
B-E11	X	Isolated Power Systems – Impedance of Isolated Wiring Test 2018 NFPA 99 6.3.2.9.2.1					
B-E14	X	Insulation Testing CEC 110.7, 2018 NFPA 99 6.7.4.1.2.2					
B-E15	X	Torque Electrical Connections CEC 110.3(B) & 110.14(D)					
B-E17	X	Nurse call system CEC 517.123					
B-E19	X	Short-Circuit Current Calculations CEC 110.24(A), 409.22, 430.99, 440.10(B)					
B-E20	X	Available Fault and Short-Circuit Current Field Marking CEC 110.16(B), 110.24(A), 620.51(D)(1), 700.5(E)					



Testing, Inspection, and Observation Program

2019 California Building Standards Code - OSHPD 1

B-E21	X	Means of Egress Illumination CBC 1008.2 and 1008.3 Illumination and Emergency Power					

MECHANICAL TESTS

B-ME7	X	Hydronics CMC 1205.2, 1220.2.6 & 1221.3 Pressure test of steam and water piping					
B-ME9	X	Pre Demolition Air Balance CMC 407.3.1 Pre-demolition Air Balance Test and Report					
B-ME10	X	Post Demolition Air Balance CMC 407.3.1 Air Balance Test and Report					
B-ME11	X	Ventilation system Air Balance CMC 407.3.1 & Table 4-A Areas tested and balanced					
B-ME12	X	Duct Leakage Test CMC 603.10.1 SMACNA HVAC Air Duct Leakage Test					

PLUMBING TESTS

B-P1	X	Disinfection of potable water systems CPC 609.9					
B-P2	X	Medical gas and vacuum NFPA 99-2018 § 5.1.12 Gas and vacuum system performance testing					
B-P3	X	Medical gas and vacuum NFPA 99-2018 § 5.1.12 Gas and vacuum system verification testing					
B-P5	X	Water supply system CPC 105.3, 105.3.2, & 609.4 Pressure tested prior to covering or concealment					
B-P6	X	Plumbing, drainage, and venting systems CPC 105.3, 105.3.2, & 712.0 Water or air tested prior to use, covering or concealment. No air test for plastic piping.					

FIRE PROTECTION AND LIFE SAFETY SYSTEMS

B-FP2	X	Fire and smoke dampers CFC 901.5 & CFC 907.8 Acceptance testing					
B-FP5	X	Fire sprinkler CFC 901.5 & NFPA 13-2016 Chapter 25 Acceptance testing – Aboveground piping					

OTHER TESTS

B-OT1	X	Radiation Shielding Barriers CBC 1705A.1.1 and 3102C Radiation shielding barrier test					
B-OT2	X	Exit Signs CBC 1013.1 Location, Illumination and Physical Characteristics					



Testing, Inspection, and Observation Program

2019 California Building Standards Code - OSHPD 1

SECTION B			NOTE: Approved agencies, individuals, and all changes to the TIO program shall be identified, evaluated by the DPOR and approved by HCAI prior to proceeding with the related work.				
Facility #:		Facility Name:		Project #:			
10619		University of California Davis Medical Center		S221899-34-00			
Stage 2: Phase 2			Select with "X" or provide required OPAA information:				
Index #	Stage 2 Required (Select with "X")	TESTS	Samples of Test & Inspection Reports Included	OPAA No. and Expiration Date	Responsible Approved Agency And/Or Individual	Compliance Verification by IOR (Initial/Date)	HCAI/FDD Use (Initial/Date)
STRUCTURAL TESTS							
Concrete							
B-C14	X	Post-installed anchors CBC 1910A.5 Installation verification test (includes adhesive, shot pins and mechanical anchors)					
B-C15	X	Existing post-installed anchors CBC 1708A and CAC Chapter 6, Section 11.3 Direct tension test					
Steel							
B-S1	X	Steel CBC 2202A.1 Identification test for structural steel and cold formed steel					
ELECTRICAL TESTS							
B-E9	X	Hospital Grade Receptacles 2018 NFPA 99 6.3.3.2.5					
B-E14	X	Insulation Testing CEC 110.7, 2018 NFPA 99 6.7.4.1.2.2					
B-E15	X	Torque Electrical Connections CEC 110.3(B) & 110.14(D)					
B-E17	X	Nurse call system CEC 517.123					
MECHANICAL TESTS							
B-ME7	X	Hydronics CMC 1205.2, 1220.2.6 & 1221.3 Pressure test of steam and water piping					
B-ME9	X	Pre Demolition Air Balance CMC 407.3.1 Pre-demolition Air Balance Test and Report					
B-ME10	X	Post Demolition Air Balance CMC 407.3.1 Air Balance Test and Report					
B-ME11	X	Ventilation system Air Balance CMC 407.3.1 & Table 4-A Areas tested and balanced					
B-ME12	X	Duct Leakage Test CMC 603.10.1 SMACNA HVAC Air Duct Leakage Test					
PLUMBING TESTS							
B-P1	X	Disinfection of potable water systems CPC 609.9					
B-P2	X	Medical gas and vacuum NFPA 99-2018 § 5.1.12 Gas and vacuum system performance testing					



Testing, Inspection, and Observation Program

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B-P3	X	Medical gas and vacuum NFPA 99-2018 § 5.1.12 Gas and vacuum system verification testing					
B-P5	X	Water supply system CPC 105.3, 105.3.2, & 609.4 Pressure tested prior to covering or concealment					
B-P6	X	Plumbing, drainage, and venting systems CPC 105.3, 105.3.2, & 712.0 Water or air tested prior to use, covering or concealment. No air test for plastic piping.					
FIRE PROTECTION AND LIFE SAFETY SYSTEMS							
B-FP2	X	Fire and smoke dampers CFC 901.5 & CFC 907.8 Acceptance testing					
B-FP5	X	Fire sprinkler CFC 901.5 & NFPA 13-2016 Chapter 25 Acceptance testing – Aboveground piping					
OTHER TESTS							
B-OT2	X	Exit Signs CBC 1013.1 Location, Illumination and Physical Characteristics					



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SECTION B			NOTE: Approved agencies, individuals, and all changes to the TIO program shall be identified, evaluated by the DPOR and approved by HCAI prior to proceeding with the related work.				
Facility #:		Facility Name:		Project #:			
10619		University of California Davis Medical Center		S221899-34-00			
Stage 3: Phase 3			Select with "X" or provide required OPAA information:				
Index #	Stage 3 Required (Select with "X")	TESTS	Samples of Test & Inspection Reports Included	OPAA No. and Expiration Date	Responsible Approved Agency And/Or Individual	Compliance Verification by IOR (Initial/Date)	HCAI/FDD Use (Initial/Date)
STRUCTURAL TESTS							
Concrete							
B-C14	X	Post-installed anchors CBC 1910A.5 Installation verification test (includes adhesive, shot pins and mechanical anchors)					
B-C15	X	Existing post-installed anchors CBC 1708A and CAC Chapter 6, Section 11.3 Direct tension test					
Steel							
B-S1	X	Steel CBC 2202A.1 Identification test for structural steel and cold formed steel					
ELECTRICAL TESTS							
B-E9	X	Hospital Grade Receptacles 2018 NFPA 99 6.3.3.2.5					
B-E14	X	Insulation Testing CEC 110.7, 2018 NFPA 99 6.7.4.1.2.2					
B-E15	X	Torque Electrical Connections CEC 110.3(B) & 110.14(D)					
B-E17	X	Nurse call system CEC 517.123					
MECHANICAL TESTS							
B-ME7	X	Hydronics CMC 1205.2, 1220.2.6 & 1221.3 Pressure test of steam and water piping					
B-ME9	X	Pre Demolition Air Balance CMC 407.3.1 Pre-demolition Air Balance Test and Report					
B-ME10	X	Post Demolition Air Balance CMC 407.3.1 Air Balance Test and Report					
B-ME11	X	Ventilation system Air Balance CMC 407.3.1 & Table 4-A Areas tested and balanced					
B-ME12	X	Duct Leakage Test CMC 603.10.1 SMACNA HVAC Air Duct Leakage Test					
PLUMBING TESTS							
B-P1	X	Disinfection of potable water systems CPC 609.9					
B-P2	X	Medical gas and vacuum NFPA 99-2018 § 5.1.12 Gas and vacuum system performance testing					



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B-P3	X	Medical gas and vacuum NFPA 99-2018 § 5.1.12 Gas and vacuum system verification testing					
B-P5	X	Water supply system CPC 105.3, 105.3.2, & 609.4 Pressure tested prior to covering or concealment					
B-P6	X	Plumbing, drainage, and venting systems CPC 105.3, 105.3.2, & 712.0 Water or air tested prior to use, covering or concealment. No air test for plastic piping.					
FIRE PROTECTION AND LIFE SAFETY SYSTEMS							
B-FP2	X	Fire and smoke dampers CFC 901.5 & CFC 907.8 Acceptance testing					
B-FP5	X	Fire sprinkler CFC 901.5 & NFPA 13-2016 Chapter 25 Acceptance testing – Aboveground piping					
OTHER TESTS							
B-OT2	X	Exit Signs CBC 1013.1 Location, Illumination and Physical Characteristics					



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SECTION B			NOTE: Approved agencies, individuals, and all changes to the TIO program shall be identified, evaluated by the DPOR and approved by HCAI prior to proceeding with the related work.				
Facility #:		Facility Name:		Project #:			
10619		University of California Davis Medical Center		S221899-34-00			
Stage 4: Phase 4a			Select with "X" or provide required OPAA information:				
Index #	Stage 4 Required (Select with "X")	TESTS	Samples of Test & Inspection Reports Included	OPAA No. and Expiration Date	Responsible Approved Agency And/Or Individual	Compliance Verification by IOR (Initial/Date)	HCAI/FDD Use (Initial/Date)
STRUCTURAL TESTS							
Concrete							
B-C14	X	Post-installed anchors CBC 1910A.5 Installation verification test (includes adhesive, shot pins and mechanical anchors)					
B-C15	X	Existing post-installed anchors CBC 1708A and CAC Chapter 6, Section 11.3 Direct tension test					
Steel							
B-S1	X	Steel CBC 2202A.1 Identification test for structural steel and cold formed steel					
ELECTRICAL TESTS							
B-E9	X	Hospital Grade Receptacles 2018 NFPA 99 6.3.3.2.5					
B-E14	X	Insulation Testing CEC 110.7, 2018 NFPA 99 6.7.4.1.2.2					
B-E15	X	Torque Electrical Connections CEC 110.3(B) & 110.14(D)					
B-E17	X	Nurse call system CEC 517.123					
MECHANICAL TESTS							
B-ME7	X	Hydronics CMC 1205.2, 1220.2.6 & 1221.3 Pressure test of steam and water piping					
B-ME9	X	Pre Demolition Air Balance CMC 407.3.1 Pre-demolition Air Balance Test and Report					
B-ME10	X	Post Demolition Air Balance CMC 407.3.1 Air Balance Test and Report					
B-ME11	X	Ventilation system Air Balance CMC 407.3.1 & Table 4-A Areas tested and balanced					
B-ME12	X	Duct Leakage Test CMC 603.10.1 SMACNA HVAC Air Duct Leakage Test					
PLUMBING TESTS							
B-P1	X	Disinfection of potable water systems CPC 609.9					
B-P2	X	Medical gas and vacuum NFPA 99-2018 § 5.1.12 Gas and vacuum system performance testing					



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B-P3	X	Medical gas and vacuum NFPA 99-2018 § 5.1.12 Gas and vacuum system verification testing					
B-P5	X	Water supply system CPC 105.3, 105.3.2, & 609.4 Pressure tested prior to covering or concealment					
B-P6	X	Plumbing, drainage, and venting systems CPC 105.3, 105.3.2, & 712.0 Water or air tested prior to use, covering or concealment. No air test for plastic piping.					
FIRE PROTECTION AND LIFE SAFETY SYSTEMS							
B-FP2	X	Fire and smoke dampers CFC 901.5 & CFC 907.8 Acceptance testing					
B-FP5	X	Fire sprinkler CFC 901.5 & NFPA 13-2016 Chapter 25 Acceptance testing – Aboveground piping					
OTHER TESTS							
B-OT2	X	Exit Signs CBC 1013.1 Location, Illumination and Physical Characteristics					



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SECTION C			NOTE: Approved agencies, individuals, and all changes to the TIO program shall be identified, evaluated by the DPOR and approved by HCAI prior to proceeding with the related work.				
Facility #:		Facility Name:		Project #:			
10619		University of California Davis Medical Center		S221899-34-00			
Stage 1: Phase 1			Select with "X" or provide required OPAA information:				
Index #	Stage 1 Required (Select with "X")	ON-SITE SPECIAL INSPECTIONS	Samples of test & inspection reports included	OPAA No. and Expiration Date	RESPONSIBLE APPROVED AGENCY AND/OR INDIVIDUAL (IDENTIFY SPECIAL INSPECTOR)	COMPLIANCE VERIFICATION BY IOR (Initial/Date)	HCAI/FDD USE (Initial/Date)
STRUCTURAL SPECIAL INSPECTIONS							
Concrete							
C-C5	X	Concrete CBC 1705A.3 CIP & Post-installed anchors					
Steel							
C-S2	X	Steel CBC 1705A.2.5 & 1705A.12.1 Shop and field welding					
C-S3	X	Steel AWS D1.1 3 & 4 and AWS D1.8 6.1 Shop and field welding - WPS / WPQR					
Nonstructural components, supports and attachments							
C-N1	X	Architectural components CBC 1705A.12.5 & 1705A.16 Cladding, nonbearing walls and veneer					
C-N2	X	Ceiling CBC 1705A.12.5 Suspended ceiling systems and their anchorage					
C-N5	X	Plumbing, mechanical and electrical components CBC 1705A.12.6 Anchorage, bracing, and vibration isolators					
C-N6	X	Special Seismic Certification CBC 1705A.12.4 Special Seismic Certification label, anchorage and mounting					
FIRE PROTECTION AND LIFE SAFETY SYSTEM SPECIAL INSPECTIONS							
C-FP3	X	Penetration firestops CBC 1705A.17.1 Penetration firestop systems that are tested and listed					
OTHER SPECIAL INSPECTIONS							
C-OT3	X	Signs CBC 11B-703.1.1.2 Signs and identification devices					



Testing, Inspection, and Observation Program

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SECTION C			NOTE: Approved agencies, individuals, and all changes to the TIO program shall be identified, evaluated by the DPOR and approved by HCAI prior to proceeding with the related work.				
Facility #:		Facility Name:		Project #:			
10619		University of California Davis Medical Center		S221899-34-00			
Stage 2: Phase 2			Select with "X" or provide required OPAA information:				
Index #	Stage 2 Required (Select with "X")	ON-SITE SPECIAL INSPECTIONS	Samples of test & inspection reports included	OPAA No. and Expiration Date	RESPONSIBLE APPROVED AGENCY AND/OR INDIVIDUAL (IDENTIFY SPECIAL INSPECTOR)	COMPLIANCE VERIFICATION BY IOR (Initial/Date)	HCAI/FDD USE (Initial/Date)
STRUCTURAL SPECIAL INSPECTIONS							
Concrete							
C-C5	X	Concrete CBC 1705A.3 CIP & Post-installed anchors					
Nonstructural components, supports and attachments							
C-N1	X	Architectural components CBC 1705A.12.5 & 1705A.16 Cladding, nonbearing walls and veneer					
C-N2	X	Ceiling CBC 1705A.12.5 Suspended ceiling systems and their anchorage					
C-N5	X	Plumbing, mechanical and electrical components CBC 1705A.12.6 Anchorage, bracing, and vibration isolators					
C-N6	X	Special Seismic Certification CBC 1705A.12.4 Special Seismic Certification label, anchorage and mounting					
FIRE PROTECTION AND LIFE SAFETY SYSTEM SPECIAL INSPECTIONS							
C-FP3	X	Penetration firestops CBC 1705A.17.1 Penetration firestop systems that are tested and listed					
OTHER SPECIAL INSPECTIONS							
C-OT3	X	Signs CBC 11B-703.1.1.2 Signs and identification devices					



Testing, Inspection, and Observation Program

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SECTION C			NOTE: Approved agencies, individuals, and all changes to the TIO program shall be identified, evaluated by the DPOR and approved by HCAI prior to proceeding with the related work.				
Facility #:		Facility Name:		Project #:			
10619		University of California Davis Medical Center		S221899-34-00			
Stage 3: Phase 3			Select with "X" or provide required OPAA information:				
Index #	Stage 3 Required (Select with "X")	ON-SITE SPECIAL INSPECTIONS	Samples of test & inspection reports included	OPAA No. and Expiration Date	RESPONSIBLE APPROVED AGENCY AND/OR INDIVIDUAL (IDENTIFY SPECIAL INSPECTOR)	COMPLIANCE VERIFICATION BY IOR (Initial/Date)	HCAI/FDD USE (Initial/Date)
STRUCTURAL SPECIAL INSPECTIONS							
Concrete							
C-C5	X	Concrete CBC 1705A.3 CIP & Post-installed anchors					
Nonstructural components, supports and attachments							
C-N1	X	Architectural components CBC 1705A.12.5 & 1705A.16 Cladding, nonbearing walls and veneer					
C-N2	X	Ceiling CBC 1705A.12.5 Suspended ceiling systems and their anchorage					
C-N5	X	Plumbing, mechanical and electrical components CBC 1705A.12.6 Anchorage, bracing, and vibration isolators					
C-N6	X	Special Seismic Certification CBC 1705A.12.4 Special Seismic Certification label, anchorage and mounting					
FIRE PROTECTION AND LIFE SAFETY SYSTEM SPECIAL INSPECTIONS							
C-FP3	X	Penetration firestops CBC 1705A.17.1 Penetration firestop systems that are tested and listed					
OTHER SPECIAL INSPECTIONS							
C-OT3	X	Signs CBC 11B-703.1.1.2 Signs and identification devices					



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SECTION C			NOTE: Approved agencies, individuals, and all changes to the TIO program shall be identified, evaluated by the DPOR and approved by HCAI prior to proceeding with the related work.				
Facility #:		Facility Name:		Project #:			
10619		University of California Davis Medical Center		S221899-34-00			
Stage 4: Phase 4a			Select with "X" or provide required OPAA information:				
Index #	Stage 4 Required (Select with "X")	ON-SITE SPECIAL INSPECTIONS	Samples of test & inspection reports included	OPAA No. and Expiration Date	RESPONSIBLE APPROVED AGENCY AND/OR INDIVIDUAL (IDENTIFY SPECIAL INSPECTOR)	COMPLIANCE VERIFICATION BY IOR (Initial/Date)	HCAI/FDD USE (Initial/Date)
STRUCTURAL SPECIAL INSPECTIONS							
Concrete							
C-C5	X	Concrete CBC 1705A.3 CIP & Post-installed anchors					
Nonstructural components, supports and attachments							
C-N1	X	Architectural components CBC 1705A.12.5 & 1705A.16 Cladding, nonbearing walls and veneer					
C-N2	X	Ceiling CBC 1705A.12.5 Suspended ceiling systems and their anchorage					
C-N5	X	Plumbing, mechanical and electrical components CBC 1705A.12.6 Anchorage, bracing, and vibration isolators					
C-N6	X	Special Seismic Certification CBC 1705A.12.4 Special Seismic Certification label, anchorage and mounting					
FIRE PROTECTION AND LIFE SAFETY SYSTEM SPECIAL INSPECTIONS							
C-FP3	X	Penetration firestops CBC 1705A.17.1 Penetration firestop systems that are tested and listed					
OTHER SPECIAL INSPECTIONS							
C-OT3	X	Signs CBC 11B-703.1.1.2 Signs and identification devices					



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SECTION D			NOTE: Approved agencies, individuals, and all changes to the TIO program shall be identified, evaluated by the DPOR and approved by HCAI prior to proceeding with the related work.				
Facility #:	Facility Name:		Project #:				
10619	University of California Davis Medical Center		S221899-34-00				
Stage 1: Phase 1			Select with "X" or provide required OPAA information:				
Index #	Stage 1 Required (Select with "X")	OFF-SITE SPECIAL INSPECTIONS	Samples of test & inspection reports included	OPAA No. and Expiration Date	RESPONSIBLE APPROVED AGENCY AND/OR INDIVIDUAL (IDENTIFY SPECIAL INSPECTOR)	COMPLIANCE VERIFICATION BY IOR (Initial/Date)	HCAI/FDD USE (Initial/Date)
STRUCTURAL SPECIAL INSPECTIONS							
Steel							
D-S1	X	Steel CBC 1705A.2 & 1705A.12.1, AISC-360 & AISC-341 Steel shop fabrication					
D-S3	X	Steel CBC 1705A.2.5 & 1705A.12.1 Shop welding					
D-S4	X	Steel AWS D1.1 3 & 4 and AWS D1.8 6.1 Shop welding - WPS / WPQR					



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SECTION D		NOTE: Approved agencies, individuals, and all changes to the TIO program shall be identified, evaluated by the DPOR and approved by HCAI prior to proceeding with the related work.					
Facility #:	Facility Name:	Project #:					
10619	University of California Davis Medical Center	S221899-34-00					
Stage 2: Phase 2		Select with "X" or provide required OPAA information:					
Index #	Stage 2 Required (Select with "X")	OFF-SITE SPECIAL INSPECTIONS	Samples of test & inspection reports included	OPAA No. and Expiration Date	RESPONSIBLE APPROVED AGENCY AND/OR INDIVIDUAL (IDENTIFY SPECIAL INSPECTOR)	COMPLIANCE VERIFICATION BY IOR (Initial/Date)	HCAI/FDD USE (Initial/Date)
No Requirements for this Section of the TIO							



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SECTION D		NOTE: Approved agencies, individuals, and all changes to the TIO program shall be identified, evaluated by the DPOR and approved by HCAI prior to proceeding with the related work.					
Facility #:	Facility Name:	Project #:					
10619	University of California Davis Medical Center	S221899-34-00					
Stage 3: Phase 3		Select with "X" or provide required OPAA information:					
Index #	Stage 3 Required (Select with "X")	OFF-SITE SPECIAL INSPECTIONS	Samples of test & inspection reports included	OPAA No. and Expiration Date	RESPONSIBLE APPROVED AGENCY AND/OR INDIVIDUAL (IDENTIFY SPECIAL INSPECTOR)	COMPLIANCE VERIFICATION BY IOR (Initial/Date)	HCAI/FDD USE (Initial/Date)
No Requirements for this Section of the TIO							



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SECTION D		NOTE: Approved agencies, individuals, and all changes to the TIO program shall be identified, evaluated by the DPOR and approved by HCAI prior to proceeding with the related work.					
Facility #:	Facility Name:		Project #:				
10619	University of California Davis Medical Center		S221899-34-00				
Stage 4: Phase 4a			Select with "X" or provide required OPAA information:				
Index #	Stage 4 Required (Select with "X")	OFF-SITE SPECIAL INSPECTIONS	Samples of test & inspection reports included	OPAA No. and Expiration Date	RESPONSIBLE APPROVED AGENCY AND/OR INDIVIDUAL (IDENTIFY SPECIAL INSPECTOR)	COMPLIANCE VERIFICATION BY IOR (Initial/Date)	HCAI/FDD USE (Initial/Date)
No Requirements for this Section of the TIO							



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SECTION E		REQUIRED COMPLIANCE FORMS			
Facility #:		Project #:			
10619		S221899-34-00			
University of California Davis Medical Center					
FORM #	Required (Select with "X")	DOCUMENT NAME	RESPONSIBLE DESIGNER OR INSTALLING CONTRACTOR	COMPLIANCE VERIFICATION BY IOR (Initial/Date)	HCAI/FDD USE (Initial/Date)
No Requirements for this Section of the TIO					



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SECTION F		CONSTRUCTION VERIFICATION										
Facility #:	Facility Name:								Project #:			
10619	University of California Davis Medical Center								S221899-34-00			
VERIFIED CONSTRUCTION INSPECTION AND OBSERVATION REPORTING												
REFERENCE NUMBER	PROJECT STAGE(S), MILESTONE, OR INTERVAL (Clearly indicate which Stage(s) apply to which Milestone/Interval)	VERIFIED COMPLIANCE REPORT REQUIRED AS INDICATED (Form OSH-FD-123) (See "PERSONAL KNOWLEDGE" as defined in California Administrative Code, Section 7-151)										HCAI/FDD USE
		GEOR	AOR	SEOR	MEOR	EEOR	CONT	IOR	SP INSP	TEST LAB		
	Clear all plan review Outstanding Items List (OIL) Items											
	Stage 1, Phase 1		X	X	X	X	X	X	X	X		
	Stage 2, Phase 2		X	X	X	X	X	X	X	X		
	Stage 3, Phase 3		X	X	X	X	X	X	X	X		
	Stage 4, Phase 4a		X	X	X	X	X	X	X	X		
	Stage 5, Phase 4b		X	X	X	X	X	X	X	X		
	Stage 6, Phase 5		X	X	X	X	X	X	X	X		
	Installation of temporary equipment											
	Removal of temporary equipment											
	Substantial Compliance (Remodel, Renovations, Maintenance projects, Equipment Replacement)		X	X	X	X	X	X	X	X		
	Certificate of Occupancy (New Buildings, Additions, Changes in Occupancy)		X	X	X	X	X	X	X	X		
	Construction Final		X	X	X	X	X	X	X	X		
ABBREVIATIONS:		GEOR - Geotechnical Engineer of Record MEOR - Mechanical Engineer of Record SP, INSP - Special Inspector			AOR - Architect of Record EEOR - Electrical Engineer of Record IOR - Inspector of Record			SEOR - Structural Engineer of Record CONT O/B - Contractor or Owner/Builder Test Lab – Engr. For the approved agency				



Testing, Inspection, and Observation Program

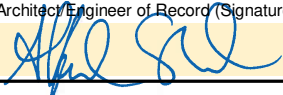
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SECTION G	Inspector of Record (IOR) Responsibility	
Facility #:	Facility Name:	Project #:
10619	University of California Davis Medical Center	S221899-34-00
INSPECTOR OF RECORD RESPONSIBILITIES. Per CAC 7-145: "The Inspector shall have personal knowledge, obtained by continuous inspection of all work of construction in all stages of its progress to ensure that the work is in accordance with the approved construction documents." This includes applicable Codes, Referenced Standards, Listings and Manufacturer's Installation Instructions applicable to the work shown in the approved construction documents. If a project has more than one inspector of record, the distribution of responsibilities for the work shall be clearly identified for each IOR per CAC 7-141(f). One IOR shall be designated as the 'lead' IOR per CAC 7-144(b). One IOR shall be assigned responsibility for "all other work" to make sure responsibility for the inspection of every part of the work is assigned.		
INSPECTOR OF RECORD CAC 7-141, 7-145 & 7-151	SCOPE OF INSPECTION	PERFORMED OFF-SITE
	All other work	



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SECTION H	HCAI REVIEWED	
Facility #:	Facility Name:	Project #:
10619	University of California Davis Medical Center	S221899-34-00
NOTE: When a structural engineer has been delegated responsibility for a portion of this project his or her signature is also required.		
Submitted By:		
I have reviewed the approved construction documents for this project and all tests and special inspections required by Code are marked as "required" on this form.		
Eric Peabody		3/23/2023
Architect/Engineer of Record (Print Name)	Architect/Engineer of Record (Signature)	Date
Alfred A. Schuchard		3/23/2023
Structural Engineer of Record (Print Name)	Structural Engineer of Record (Signature)	Date
FOR HCAI USE		
TIO Program Reviewed by HCAI Plan Review Staff:		
 TIO REVIEWED Department of Health Care Access & Information Office of Statewide Hospital Planning & Development 5/3/2023, 2:22:30 PM S221899-34-00 Donald Harris		
Note: HCAI plan review staff must provide verification that the TIO program has been "Reviewed" prior to plan approval to confirm the applicability of the tests and inspections identified in the TIO program for work scope, building systems, and the construction materials shown in the design drawings. Field staff will issue subsequent "TIO Program Approval".		



Testing, Inspection, and Observation Program

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SECTION I		TIO PROGRAM APPROVAL	
Facility #:	Facility Name:	Project #:	
10619	University of California Davis Medical Center	S221899-34-00	
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, acute psychiatric hospitals, and general acute care hospitals providing only acute medical rehabilitation center services (2019 CBC 1224.1).			
Samples of Test and Inspection Reports are <i>NOT</i> required for tests performed by laboratories approved through OPAA Program			
<i>All test and special inspection reports shall be submitted to the IOR, hospital owner, architect in responsible charge, and the structural engineer by the testing agency per CAC 7-149(a).</i>			
<i>Verified compliance reports shall be signed by the individual who performed the special inspection(s) as outlined in CAC 7-151 (c). All reports shall clearly state whether the tests or special inspections were performed in accordance with the HCAI stamped approved documents and whether the results indicate compliance with those documents per CAC 7-149 (a). All IORs performing special inspections shall hold the appropriate certification and equipment, and shall obtain approval from the design professional of record and HCAI prior to performing such work.</i>			
NOTE: This Test, Inspection, and Observation Report shall be approved by HCAI field personnel prior to start of construction.			
Eric Peabody	C-31787		3/23/2023
Architect/Engineer of Record (Print Name)	Professional License #	Architect/Engineer of Record (Signature)	Date
FOR HCAI FIELD STAFF USE			
TIO Program Approved by HCAI Field Staff:			
Note: HCAI plan review staff must provide verification that the TIO program has been "Reviewed" prior to plan approval to confirm the applicability of the tests and inspections identified in the TIO program for work scope, building systems, and the construction materials shown in the design drawings. HCAI Field staff will issue subsequent "TIO Program Approval".			
If "Approved with Comments" is checked the following comments shall be resolved by the designer prior to proceeding with the related construction:			



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[illegible]



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Construction shall not commence until the health facility has obtained from HCAI "TIO Program Approval".
(CAC Section 7-135(a)3)



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SECTION B			NOTE: Approved agencies, individuals, and all changes to the TIO program shall be identified, evaluated by the DPOR and approved by HCAI prior to proceeding with the related work.				
Facility #:		Facility Name:		Project #:			
10619		University of California Davis Medical Center		S221899-34-00			
Stage 5: Phase 4b			Select with "X" or provide required OPAA information:				
Index #	Stage 5 Required (Select with "X")	TESTS	Samples of Test & Inspection Reports Included	OPAA No. and Expiration Date	Responsible Approved Agency And/Or Individual	Compliance Verification by IOR (Initial/Date)	HCAI/FDD Use (Initial/Date)
STRUCTURAL TESTS							
Concrete							
B-C14	X	Post-installed anchors CBC 1910A.5 Installation verification test (includes adhesive, shot pins and mechanical anchors)					
B-C15	X	Existing post-installed anchors CBC 1708A and CAC Chapter 6, Section 11.3 Direct tension test					
Steel							
B-S1	X	Steel CBC 2202A.1 Identification test for structural steel and cold formed steel					
ELECTRICAL TESTS							
B-E9	X	Hospital Grade Receptacles 2018 NFPA 99 6.3.3.2.5					
B-E14	X	Insulation Testing CEC 110.7, 2018 NFPA 99 6.7.4.1.2.2					
B-E15	X	Torque Electrical Connections CEC 110.3(B) & 110.14(D)					
B-E17	X	Nurse call system CEC 517.123					
MECHANICAL TESTS							
B-ME7	X	Hydronics CMC 1205.2, 1220.2.6 & 1221.3 Pressure test of steam and water piping					
B-ME9	X	Pre Demolition Air Balance CMC 407.3.1 Pre-demolition Air Balance Test and Report					
B-ME10	X	Post Demolition Air Balance CMC 407.3.1 Air Balance Test and Report					
B-ME11	X	Ventilation system Air Balance CMC 407.3.1 & Table 4-A Areas tested and balanced					
B-ME12	X	Duct Leakage Test CMC 603.10.1 SMACNA HVAC Air Duct Leakage Test					
PLUMBING TESTS							
B-P1	X	Disinfection of potable water systems CPC 609.9					
B-P2	X	Medical gas and vacuum NFPA 99-2018 § 5.1.12 Gas and vacuum system performance testing					



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B-P3	X	Medical gas and vacuum NFPA 99-2018 § 5.1.12 Gas and vacuum system verification testing					
B-P5	X	Water supply system CPC 105.3, 105.3.2, & 609.4 Pressure tested prior to covering or concealment					
B-P6	X	Plumbing, drainage, and venting systems CPC 105.3, 105.3.2, & 712.0 Water or air tested prior to use, covering or concealment. No air test for plastic piping.					
FIRE PROTECTION AND LIFE SAFETY SYSTEMS							
B-FP2	X	Fire and smoke dampers CFC 901.5 & CFC 907.8 Acceptance testing					
B-FP5	X	Fire sprinkler CFC 901.5 & NFPA 13-2016 Chapter 25 Acceptance testing – Aboveground piping					
OTHER TESTS							
B-OT2	X	Exit Signs CBC 1013.1 Location, Illumination and Physical Characteristics					



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SECTION C			NOTE: Approved agencies, individuals, and all changes to the TIO program shall be identified, evaluated by the DPOR and approved by HCAI prior to proceeding with the related work.				
Facility #:		Facility Name:		Project #:			
10619		University of California Davis Medical Center		S221899-34-00			
Stage 5: Phase 4b			Select with "X" or provide required OPAA information:				
Index #	Stage 5 Required (Select with "X")	ON-SITE SPECIAL INSPECTIONS	Samples of test & inspection reports included	OPAA No. and Expiration Date	RESPONSIBLE APPROVED AGENCY AND/OR INDIVIDUAL (IDENTIFY SPECIAL INSPECTOR)	COMPLIANCE VERIFICATION BY IOR (Initial/Date)	HCAI/FDD USE (Initial/Date)
STRUCTURAL SPECIAL INSPECTIONS							
Concrete							
C-C5	X	Concrete CBC 1705A.3 CIP & Post-installed anchors					
Nonstructural components, supports and attachments							
C-N1	X	Architectural components CBC 1705A.12.5 & 1705A.16 Cladding, nonbearing walls and veneer					
C-N2	X	Ceiling CBC 1705A.12.5 Suspended ceiling systems and their anchorage					
C-N5	X	Plumbing, mechanical and electrical components CBC 1705A.12.6 Anchorage, bracing, and vibration isolators					
C-N6	X	Special Seismic Certification CBC 1705A.12.4 Special Seismic Certification label, anchorage and mounting					
FIRE PROTECTION AND LIFE SAFETY SYSTEM SPECIAL INSPECTIONS							
C-FP3	X	Penetration firestops CBC 1705A.17.1 Penetration firestop systems that are tested and listed					
OTHER SPECIAL INSPECTIONS							
C-OT3	X	Signs CBC 11B-703.1.1.2 Signs and identification devices					



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SECTION D		NOTE: Approved agencies, individuals, and all changes to the TIO program shall be identified, evaluated by the DPOR and approved by HCAI prior to proceeding with the related work.					
Facility #:	Facility Name:	Project #:					
10619	University of California Davis Medical Center	S221899-34-00					
Stage 5: Phase 4b		Select with "X" or provide required OPAA information:					
Index #	Stage 5 Required (Select with "X")	OFF-SITE SPECIAL INSPECTIONS	Samples of test & inspection reports included	OPAA No. and Expiration Date	RESPONSIBLE APPROVED AGENCY AND/OR INDIVIDUAL (IDENTIFY SPECIAL INSPECTOR)	COMPLIANCE VERIFICATION BY IOR (Initial/Date)	HCAI/FDD USE (Initial/Date)
No Requirements for this Section of the TIO							



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SECTION B			NOTE: Approved agencies, individuals, and all changes to the TIO program shall be identified, evaluated by the DPOR and approved by HCAI prior to proceeding with the related work.				
Facility #:		Facility Name:		Project #:			
10619		University of California Davis Medical Center		S221899-34-00			
Stage 6: Phase 5			Select with "X" or provide required OPAA information:				
Index #	Stage 6 Required (Select with "X")	TESTS	Samples of Test & Inspection Reports Included	OPAA No. and Expiration Date	Responsible Approved Agency And/Or Individual	Compliance Verification by IOR (Initial/Date)	HCAI/FDD Use (Initial/Date)
STRUCTURAL TESTS							
Concrete							
B-C14	X	Post-installed anchors CBC 1910A.5 Installation verification test (includes adhesive, shot pins and mechanical anchors)					
B-C15	X	Existing post-installed anchors CBC 1708A and CAC Chapter 6, Section 11.3 Direct tension test					
Steel							
B-S1	X	Steel CBC 2202A.1 Identification test for structural steel and cold formed steel					
ELECTRICAL TESTS							
B-E9	X	Hospital Grade Receptacles 2018 NFPA 99 6.3.3.2.5					
B-E14	X	Insulation Testing CEC 110.7, 2018 NFPA 99 6.7.4.1.2.2					
B-E15	X	Torque Electrical Connections CEC 110.3(B) & 110.14(D)					
B-E17	X	Nurse call system CEC 517.123					
MECHANICAL TESTS							
B-ME7	X	Hydronics CMC 1205.2, 1220.2.6 & 1221.3 Pressure test of steam and water piping					
B-ME9	X	Pre Demolition Air Balance CMC 407.3.1 Pre-demolition Air Balance Test and Report					
B-ME10	X	Post Demolition Air Balance CMC 407.3.1 Air Balance Test and Report					
B-ME11	X	Ventilation system Air Balance CMC 407.3.1 & Table 4-A Areas tested and balanced					
B-ME12	X	Duct Leakage Test CMC 603.10.1 SMACNA HVAC Air Duct Leakage Test					
PLUMBING TESTS							
B-P1	X	Disinfection of potable water systems CPC 609.9					
B-P2	X	Medical gas and vacuum NFPA 99-2018 § 5.1.12 Gas and vacuum system performance testing					



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B-P3	X	Medical gas and vacuum NFPA 99-2018 § 5.1.12 Gas and vacuum system verification testing					
B-P5	X	Water supply system CPC 105.3, 105.3.2, & 609.4 Pressure tested prior to covering or concealment					
B-P6	X	Plumbing, drainage, and venting systems CPC 105.3, 105.3.2, & 712.0 Water or air tested prior to use, covering or concealment. No air test for plastic piping.					
FIRE PROTECTION AND LIFE SAFETY SYSTEMS							
B-FP2	X	Fire and smoke dampers CFC 901.5 & CFC 907.8 Acceptance testing					
B-FP5	X	Fire sprinkler CFC 901.5 & NFPA 13-2016 Chapter 25 Acceptance testing – Aboveground piping					
OTHER TESTS							
B-OT2	X	Exit Signs CBC 1013.1 Location, Illumination and Physical Characteristics					



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10619		University of California Davis Medical Center		S221899-34-00			
Stage 6: Phase 5			Select with "X" or provide required OPAA information:				
Index #	Stage 6 Required (Select with "X")	ON-SITE SPECIAL INSPECTIONS	Samples of test & inspection reports included	OPAA No. and Expiration Date	RESPONSIBLE APPROVED AGENCY AND/OR INDIVIDUAL (IDENTIFY SPECIAL INSPECTOR)	COMPLIANCE VERIFICATION BY IOR (Initial/Date)	HCAI/FDD USE (Initial/Date)
STRUCTURAL SPECIAL INSPECTIONS							
Concrete							
C-C5	X	Concrete CBC 1705A.3 CIP & Post-installed anchors					
Nonstructural components, supports and attachments							
C-N1	X	Architectural components CBC 1705A.12.5 & 1705A.16 Cladding, nonbearing walls and veneer					
C-N2	X	Ceiling CBC 1705A.12.5 Suspended ceiling systems and their anchorage					
C-N5	X	Plumbing, mechanical and electrical components CBC 1705A.12.6 Anchorage, bracing, and vibration isolators					
C-N6	X	Special Seismic Certification CBC 1705A.12.4 Special Seismic Certification label, anchorage and mounting					
FIRE PROTECTION AND LIFE SAFETY SYSTEM SPECIAL INSPECTIONS							
C-FP3	X	Penetration firestops CBC 1705A.17.1 Penetration firestop systems that are tested and listed					
OTHER SPECIAL INSPECTIONS							
C-OT3	X	Signs CBC 11B-703.1.1.2 Signs and identification devices					



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SECTION D		NOTE: Approved agencies, individuals, and all changes to the TIO program shall be identified, evaluated by the DPOR and approved by HCAI prior to proceeding with the related work.					
Facility #:	Facility Name:	Project #:					
10619	University of California Davis Medical Center	S221899-34-00					
Stage 6: Phase 5		Select with "X" or provide required OPAA information:					
Index #	Stage 6 Required (Select with "X")	OFF-SITE SPECIAL INSPECTIONS	Samples of test & inspection reports included	OPAA No. and Expiration Date	RESPONSIBLE APPROVED AGENCY AND/OR INDIVIDUAL (IDENTIFY SPECIAL INSPECTOR)	COMPLIANCE VERIFICATION BY IOR (Initial/Date)	HCAI/FDD USE (Initial/Date)
No Requirements for this Section of the TIO							

SECTION 01 51 00
TEMPORARY UTILITIES

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, Data, and WIFI.

1.02 RELATED SECTIONS

- A. Section 011100 – SUMMARY OF THE WORK
- B. Section 013500 – SPECIAL PROCEDURES: General requirements for temporary facilities and controls, to accommodate the University's occupancy and use of the areas and spaces adjacent to construction.
- C. Section 015610 – AIRBORNE CONTAMINANTS CONTROL
- D. Section 017400 – CLEANING
- E. Section 017700 – 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. The services will be provided at the current rates for each utility.

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 017400 – CLEANING.
2. Distribution: Contractor shall provide distribution network for temporary electrical power.
3. Power Source: Arrange for service with University's Plant Operations and Maintenance Department, or local utility company.
4. Conformance: All temporary wiring and electrical facilities shall be in accordance with applicable provisions of Electrical Safety Orders of the State of California.
5. Temporary Lighting: Construction lighting shall be supplied and maintained by Contractor at Contractor's expense. Sufficient lighting levels shall be provided to allow construction to be properly and safely performed. Contractor shall give special attention to adequate lighting for stairs, ladders, floor openings, basements and similar spaces. Promptly replace burnt out, worn or defective parts.
6. Lighting fixtures: Locate fixtures in areas of Work: One (1) lamped fixture in rooms, except closets and utility chases; one (1) lamped fixture for every 750 square feet in large areas.
7. Security Lighting: Contractor shall provide security lighting during hours of low visibility.

B. Distribution requirements:

1. Weatherproof distribution boxes with one (1) - 240-volt, three (3) phase power outlet and four (4) – 120-volt outlets consisting of 100 amperes fused switches with equipment ground, spaced so a 100-foot extension cord will reach all areas of building.
2. Wiring, connections and protection for temporary lighting.
3. Wiring connections and protection for temporary and permanent equipment, for environmental control, for temporary use of electricity operated equipment, and for testing.

C. Use of University System: If alternate electrical power and lighting sources are unavailable, University may permit Contractor to use existing, in-place electrical system. University does not guarantee availability of electrical power or adequate lighting levels through use of existing system. If power and lighting is insufficient or not available Contractor shall provide secondary source (i.e., generator) as approved by University.

1. It is expressly understood and agreed by Contractor that University existing power and lighting system's primary obligation is servicing patient care. The University system is not designed for purposes of construction activities.
2. Contractor should expect power and lighting interruptions during course of Work. Contractor will be required to cease use of University electrical-power and lighting systems, as required by the needs of University.
3. When use of University electrical system is approved in writing, Contractor is required to adhere to University's electrical lockout procedures. See Division 26– Electrical or Campus Design Guidelines.
 - 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 SECTION 015610 – 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 33 and 22 for requirements or Campus Design Guidelines
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 $\frac{7}{8}$ " 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 013500 – SPECIAL PROCEDURES.

1.08 TEMPORARY TELEPHONE, DATA, INTERNET, and WIFI

- 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, data internet, and WIFI 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, data, internet and WIFI service.
 3. Contractor shall select number of lines, instruments and other features.
 4. Contractor shall prepare and submit to University an itemized request for telephone lines (according to option 2a or 2b above) and internet service. Project Manager will submit a service request to the IT department.
- 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.
 - c. Plant Operations & Maintenance communication devices.
 - d. Microwave transmission stations.
 - e. UC Davis Health closed-circuit television or radio signals.
 - f. Cellular or other mobile phone systems in main hospital.
 - g. UC Davis Health voice or digital paging systems.

- E. Temporary Internet Service: Provide a high-speed internet connection (Min. 20 Mbps download, 10 Mbps upload) to Contractor's field offices. The Contractor's and University's field offices shall be capable of sending and receiving e-mail and be able access the Internet.

1. **NOT USED**

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.
- D. Modems compatible with internet service.

PART III - EXECUTION

3.01 INTERRUPTION OF EXISTING SERVICES

- A. No existing utility services shall be interrupted at any time without prior written approval from the University. Required shutdowns shall be scheduled a minimum of fourteen calendar days prior to actual shutdown. The operation of valves, switches, etc. will be performed and paid for by University.
 - 1. Prior to the outage, all possible Work shall have been completed which will minimize the length of the required outage. During the outage, the Work will be prosecuted with diligence by an adequate number of skilled personnel.
 - 2. Provide and pay for all personnel required by the University to maintain safe conditions during the outage including but not limited to fire watch, safety monitors and/or traffic control. Coordinate Work with University's Representative.

3.02 REMOVAL OF TEMPORARY CONSTRUCTION

- A. At the completion of the Work, the Contractor shall remove from the Project site all temporary utilities and services construction. Leave the Project site clean and free from debris, materials, or equipment.

END OF SECTION 01 51 00

SECTION 01 55 00

VEHICULAR ACCESS AND PARKING

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 011100 – SUMMARY OF THE WORK
- B. Section 013300 – SHOP DRAWINGS, PRODUCT DATA AND SAMPLES
- C. Section 013500 – 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 017400 – CLEANING
- E. Section 017700 – 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.
 - 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.
 1. Fire Lanes to remain open at all times and shall not be blocked without a Traffic Control Plan provided prior to work at the Fire Lane and approved by the University's Representative.
- 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, Traffic Message Boards, Cones, Drums, Flares, Lights and Flag Control equipment: All as approved by California MUTCD requirements.
 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 (NOT USED)

PART II - PRODUCTS – Not Applicable to this Section

PART III - EXECUTION – Not Applicable to this Section

END OF SECTION 01 55 00

SECTION 01 56 00

TEMPORARY BARRIERS, ENCLOSURES and CONTROLS

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 011100 – SUMMARY OF THE WORK
- B. Section 013500 – SPECIAL PROCEDURES
- C. Section 013900 - GREEN BUILDING POLICY IMPLEMENTATION
- D. Section 015610 – AIRBORNE CONTAMINANTS CONTROL
- E. Section 017400 – 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 per California MUTCD requirements.
- B. Partitions and Ceiling Enclosures:
 - 1. Fire Enclosures-Rated-Corridors and Rated Assemblies: Provide non-combustible dust-proof barrier framed with 20-gauge metal studs spaced 24" o/c maximum and covered on both sides with 5/8" thick Type-X rated gypsum wallboard fire 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, TX77033 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 University 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.
- C. Critical access and protected walkways shall comply with the CBC and CFC.

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 the 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. Noise Control: Control noise as directed by University's Representative.
- C. 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.

- D. 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 UC Davis Health 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 013500 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 the campus, as directed by University, to be selectively sorted by the University; remaining debris shall be disposed of by Contractor at no expense to University.
- E. 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 watercourses. Silt deposited as a result of the Work shall be removed and disposed of by Contractor at no cost to the University.
1. Rough grade site to prevent standing water and to direct surface drainage away from excavations, trenches, adjoining properties and public rights-of-way/s.
 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. Winterize and stabilize site with Geotextile Fabric and gravel so that the site drains and avoids it becoming a quagmire. Maintain access roads on the site with Geotextile Fabric and gravel and make repairs to avoid furrow, ruts, or potholes.
 6. Remove equipment and installation when no longer needed.

- F. 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][CM/Contractor][Design-Builder]** 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 jobsite.

PART II - PRODUCTS

- 2.01 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.

PART III - EXECUTION

- 3.01 Infection Control Risk Assessment ICRA Requirements:

- A. ****DELETE SECTION IF NON-PATIENT CARE SPACE*** NON-CLINICAL DUST CONTROL COVERED BY 1.03***
1. Refer to attached Infection Control Risk Assessment (ICRA) and UC Davis Health Construction Dust & Hazardous Materials Inspection Worksheet.
 - 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 work containment shall have present: ICRA Permit, 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 University employees, and an emergency telephone number of persons 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 University representative. Work cannot begin until the work containment has been inspected and approved.

3.02 Refer to the following Attachments:

- A. Appendix A - Construction Dust & Hazardous Materials Inspection Worksheet
- B. Appendix B - Initial Information and Benchmark Containment Inspections
- C. Appendix C - Entry Warning Sign with Project Manager Contact Information

END OF SECTION 01 56 00

UC DAVIS HEALTH CONSTRUCTION DUST & HAZARDOUS MATERIALS INSPECTION WORKSHEET – APPENDIX A

ICRA Permit Number	ICRA Class
Job # and Name	Project Manager
Estimated Start	Estimated Completion

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

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

VERIFICATION OF WORK

Type(s) of Inspection Required	Responsible Party
☐ HEPA Equipment Verification	☐ EH&S ☐ Consultant ☐ Other:
☐ Pre-Work Approval Inspection	☐ EH&S ☐ Consultant ☐ Other:
☐ Daily Onsite Oversight	☐ PM ☐ EH&S ☐ Consultant ☐ IOR ☐ Other:
☐ Air Sampling Type: _____ Frequency: _____	☐ EH&S ☐ Consultant ☐ Other:
☐ Demolition Inspection	☐ PM ☐ EH&S ☐ Consultant ☐ IOR ☐ Other:
☐ ICRA Downgrade	☐ PM ☐ EH&S ☐ Consultant ☐ IOR ☐ Other:
☐ Final Visual Approval Inspection	☐ PM ☐ EH&S ☐ Consultant ☐ IOR ☐ Other:

INITIAL INFORMATION AND BENCHMARK CONTAINMENT INSPECTIONS – APPENDIX B

ICRA #	Location	Set Up Date	Electrical Shop Inspection	Pre-Start Inspection (Name, Date, Time)	Post-Demo Inspection (Name, Date, Time)	Downgrade Inspection (Name, Date, Time)	Final Ins (Name, Da

DAILY INSPECTION LOG

Date & Time	Performed By(Name)	Pressure Reading (+/-)	Acceptable Negative Pressure? (Y/N)	ILSM conditions still met? (Y/N/n/a)	Tack Mat useable? (Y/N)	Interior free of dust/debris? (Y/N)	Containment Integrity Intact (no holes or breaches)? (Y/N)	All ICRA permit conditions met? (Y/N)	Oth (E
Example 7/4/16 – 0800	B. Clean	-0.025	Y	Y	Y	Y	Y	Y	

ENTRY WARNING SIGN WITH PROJECT MANAGER CONTACT INFORMATION – APPENDIX C

CAUTION

CONSTRUCTION DUST PRECAUTIONS DO NOT ENTER

For More Information Contact the Project Manager

(Name)

Phone Number

(THIS SIGN MUST BE POSTED IN COLOR)

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, as well as non-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 or other airborne contaminants 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.
- C. All work at hospital facilities shall follow the recommended UC Davis Medical Center Construction Dust Infection Prevention Best Practices Standard, Version 4.0 – December 2022 or the most recent version.
- D. Should the scope of work change or the discovery of additional toxic materials such as asbestos, lead and radioactive materials or biological substances such as visible mold growth, STOP WORK and seek additional approval and guidance before proceeding. If the above potential materials newly discovered 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 University's Representative immediately. This includes projects that are already considered and operating under a Class IV.
- E. Related Sections:
 - 1. Section 017300 – CUTTING AND PATCHING: Removal of debris may be outside of normal work hours and shall be in tightly covered containers.
 - 2. Section 013500 – SPECIAL PROCEDURES: Perform work in accordance with requirements of this section.

3. Section 013900 - GREEN BUILDING POLICY IMPLEMENTATION
4. Section 015100 – TEMPORARY UTILITIES: Provide high efficiency particulate air (HEPA) filters as specified in Section 015610, negative pressure ventilation, or special control of existing system as determined by University's Representative.
5. Section 015600 – TEMPORARY BARRIERS, ENCLOSURES AND CONTROLS: Extend barriers above ceilings as required to seal off and contain airborne contaminants.
6. Section 015600 – TEMPORARY CONTROLS: Contain waste materials during removal; bagging, wrapping, and transporting.
7. Section 017400 – 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 and clean work area daily. Excess construction debris shall be cleaned daily by the end of each work shift. Disinfect Containment and Protection Areas as directed by University's Representative

F. Dust Mitigation Requirements

1. An ICRA Daily Inspection Log is attached at the end of this section under UC Davis Health Construction Dust Infection Prevention Best Practice Standard. 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.

G. UC Davis Health Construction Dust Infection Prevention Best Practice Standard

- a. The UC Davis Health Construction Dust Infection Prevention Best Practice Standard is attached at the end of this Section and augments information & requirements of Section 015610.
- b. Refer to the UC Davis Health Construction Dust Infection Prevention Best Practice Standard per requirements for.
 - 1) Responsibilities
 - 2) Procedures
 - 3) Training And Certifications
 - 4) Containment Design & Construction
 - 5) Materials And Equipment
 - 6) Cleaning Procedures
 - 7) Documentation
 - 8) Containment Verification

- 9) Inspection Criteria
- 10) And other Dust Infection Prevention Measures

1.03 SUBMITTALS

- A. Submit to Project Inspector or Post at Anteroom Daily ICRA Inspection Log.
- B. Schedules: Submit work areas and procedure schedules for containment of airborne contaminants. Include this work in the Project Schedule per 013200.
- C. Detailed Work Plan: Drawings including but not limited to Work Area/ Floor Plan, Path of Travel, Egress and Exiting, Rated Construction 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.
 - 1. As applicable, the drawing should include the following: location of ante room(s), location of manometer, location of negative air units exhausting outside the construction area including number of negative air units and sizes (cfm), and location of sealed blocked off areas of corridors. If the exhaust of the negative air unit(s) cannot be exhausted outside of the building, the work plan shall include details, product documents and drawings of the approved fire-rated assemblies that will be used to meet Fire Codes (if applicable), Building Codes and ILSM requirements. Any impacts to corridors will need to be approved via ILSM (see specification section 013500 for details).
 - 2. Identify the areas surrounding the project area, assessing potential impact of construction on the patient care area. Identify the specific uses (e.g., patient rooms, medication room, operating room, etc.)
 - 3. Identify the potential impacts including but not limited to.
 - a. HVAC, Ventilation (outages, air flow directions, clean to dirty, air intakes/exhausts, air balance, disruptions, etc.).
 - b. Plumbing (outages, hand-washing access, work area, flushing/draining systems, charging systems, disinfecting systems, etc.).
 - c. Electricity (outages for critical equipment, special ventilation areas, monitoring).
 - d. Identify Airborne infection isolation rooms and patient rooms with immuno-compromised conditions that will require High-efficiency Particulate Air (HEPA) filters.
 - 4. Identify containment measures including but not limited to types of barriers to be used. HEPA filtration to be used. Renovation/construction areas should be isolated from occupied areas during construction and provide clean-to-dirty airflow with respect to surrounding areas.
 - 5. Assess preventive maintenance requirements. Will the service/maintenance frequency and level of service of systems need to be modified during construction (e.g., ventilation filters, air intake system, potable water, plumbing, doors). Work Hours: Can or will the work be done during non-patient care hours?

6. Include provisions for but not limited to traffic flow, entrance, egress, control, debris removal and housekeeping.
 7. Work Hours: Identify areas of work that will be done during non-patient care hours. Refer to Sections 011100 Summary of Work and Section 011400 Work Restrictions
 8. The Detailed Work Plan shall be reviewed and approved by the University's Representative prior to the start of Construction.
- D. Project Experience and Training: In order to be considered qualified to work with negative pressure containments; **Contractor's** must demonstrate experience by providing either of the following:
1. Previously completed, documented negative pressure containment work in a healthcare facility along with an owner reference. Minimum documentation shall include project descriptions and photographs or containment schematics.
 2. Documentation that the contractors' proposed foreman has successfully obtained one of the following from the American Society for Healthcare Engineering (ASHE):
 - a. Certified Healthcare Constructor (CHC) Certification
 - b. Health Care Construction (HCC) Certificate
 - c. Managing Infection Prevention During the Construction & Operation of Health Care Facilities Course Completion
 - d. Completion of an ICRA training course approved by University
 3. Documentation that all contractor employees and subcontractor's employees have successfully completed an ICRA training class that is approved by University. All personnel working with negative pressure containments shall be trained and knowledgeable in the following:
 - a. ICRA Permit contents and requirements
 - b. Site specific containment plan requirements that follow best management practices
 - c. Infection risks associated with construction
 - d. Methods to control the dissemination of dust and fungal spores
 - e. Proper use of protective clothing
 - f. Proper entry and exit procedures
 - g. Manufacturer's requirements, where manufactured containment systems are used (e.g., portable pop-up cubes)
 - h. How to respond to a loss of negative pressure or too much negative pressure
 - i. Breach in practice response and required notifications

4. Contractors shall be additionally trained in the following:
 - a. Proper containment design, construction, and maintenance techniques
 - b. Proper load out techniques for equipment/wastes
 - c. Containment cleaning regime: daily, final, and terminal cleaning
5. Containment failure emergencies caused by the contractor may require retraining at the discretion of the University's Representative Infection Control, or Environmental Health & Safety. Training is to be provided by University Environmental Health & Safety or a University approved training consultant.

6.

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 as required in their ICRA work plan.
- B. Review by PO&M HVAC staff for possibility to disconnect air supply and return into the project area
- C. Review by University Plant Operation & Maintenance Electrical staff for required electrical needs.
- D. Negative air machines shall be connected to separate electrical circuits.
- E. 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, electrical outlets, gaps at ceilings and other openings within the area where contaminants can escape. Sealing the critical openings can be accomplished with fire-rated tape, fire-rated plastic, fire-rated 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 Contractor's. 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 (ICRA permit) issued by Infection Prevention requiring compliance with one of five precaution levels. The ICRA program is documented in Hospital P&P 2120. ICRAs apply to patient care areas and their adjoining contiguous areas. All ICRA evaluations are the sole responsibility of the Health System Infection Prevention Department based on an application by the Project Manager. ICRA Permits expire and can be extended subject to approval by the Infection Prevention Department.

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 UC Davis Health 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 V and approved ICRA Permit.
3. **Contractor** shall ensure that all workers are trained and adhere to the mitigation requirements including provisions indicated per UC Davis Health Construction Dust Infection Prevention Best Practice Standard attached at the end of this Section.
4. The contractor shall ensure that all site workers, including subcontractors, are knowledgeable of the requirements of plans, specifications and approved ICRA permit precautions and the reasons for controlling construction dust.
5. The contractor is required to stop work at times of excessive noise/vibration, when containment is breached, when this standard is not being complied with and when directed by University Representatives.
6. **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.
7. If project construction activities will occur beyond the expiration date identified in the ICRA Permit, **Contractor** shall coordinate with University's Representative to

request extension of the ICRA Permit utilizing the ICRA 2.0 PermitForm attached provided at the end of in this section.

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.
- B. Approved one-hour fire-rated temporary containment systems that meet ASTM E84, Class A requirements for smoke and fire for fire rated assemblies/enclosures.
- C. Fire-rated tape for sealing critical barriers and attaching plastic to building components.
- D. Approved fire damper systems used to control smoke/fire in a fire-rated containment assembly.

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. See attached ICRA Permit and associated worksheets.

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 University employees, an emergency telephone number of person to call 24 hours a day in the event of a negative pressure alarm or other issue, and that an Environment of Care Incident Report under the category of "Construction Dust" must be filed by area nursing management in case of constant or annoying alarms.
- B. The interior of the containment area shall be cleaned on a continual basis daily. Hard surface floors in work area, adjacent hallways and passage areas require vacuuming with HEPA-filtered vacuum cleaners and frequent wet-mopping during demolition and construction; protect adjacent carpeted areas with plastic and plywood and vacuum with HEPA-filtered vacuum cleaners. Only an EPA Listed Germicide approved by the UC Davis Health Infection Prevention shall be used on the project site.
- C. Contractor shall inspect the containment daily prior to starting work and immediately repair any breaches, holes, or other issues.
- D. For projects of extended length when work activity is not being performed, including on weekend or holiday periods, and if the work area had a very thorough surface cleaning and received a passing visual inspection by a third-party environmental consultant, the daily inspections are not required. At a minimum, ICRA inspections shall be made weekly for containments on projects of extended non-work activity.
- E. 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.

F. 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 fire-rated 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 as critical barriers. Materials used to block off these critical barriers in a temporary construction area not exceeding 30 days may be constructed of 6-mil fire-rated plastic. Materials used to block off these critical barriers in a construction area exceeding 30 days shall be constructed of an approved fire-resistive material other than 6 mil plastic.
4. All polyethylene (plastic) 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. Flapped doorways consisting of overlapping plastic are not acceptable in the building.
5. Creation of the negative pressure enclosure includes the requirement to complete temporary barrier walls in the attic space from the top of the ceiling to the underside of the roof deck in the project area when the ceiling system is opened.
6. Creation of negative pressure enclosure includes sealing wall cavities that are opened to prevent air transmission between adjacent spaces and the attic space that has air pathway to the attic space.
7. For temporary construction projects that do not exceed 30 calendar days, temporary work area containments may be constructed of 6-mil fire-rated polyethylene. Approval for this shall be by the Fire Marshal.
8. For projects that exceed 30 calendar days, all barriers used to construct the temporary containment systems in the project area shall be hard barriers that meet the ASTM E84, Class A requirements for smoke and fire. This will include the use of a hard door integral to the temporary containment system to allow access and egress to and from the construction area.
9. Smoke detectors that are present inside of the construction work area can be temporarily covered during the work shift with a loose-fitting plastic "shower cap" that is commonly used on projects to prevent smoke alarms from inadvertently being triggered from dust. If this temporary dust control measure is used, the plastic covers shall be removed at the end of each work shift.

G. 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.

H. Double Ante Rooms with Negative Air Unit Attached to One Ante Room

1. In some locations when the negative air exhaust cannot be directed outside the building, and while temporary barriers are being installed, use of two anterooms connected in series to the construction zone may be used temporarily until full negative pressure containment is achieved. The use of double anterooms is a temporary measure and shall not be considered a primary means of negative pressure for control of dust. It must receive approval by Infection Prevention or EH&S before it can be considered. The configuration includes two anterooms connected with the clean anteroom accessible from the corridor, room, or space to access the project area. The second anteroom is connected to the construction work area.
2. If approved, a HEPA filtered negative air unit shall be attached to the anteroom that is connected directly to the construction work area. This anteroom is considered the "dirty" anteroom because air is drawn into this room from the construction area. The first anteroom accessible from the corridor, room or space is considered a "clean" anteroom because air is unidirectional, moving into the second anteroom.

I. 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 shall have a HEPA filtered negative air unit attached or integral to the cube to create a negative pressure work environment inside of the cube. Cubes are reviewed and approved by the University's Representative on a case-by-case basis.

J. 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.

K. 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. HEPA filtered air shall not be discharged into existing HVAC supply ducts, return ducts, exhaust ducts or building plenum spaces unless there is a dedicated exhaust duct available in the construction project area and is approved for use by the University Plant Operations & Maintenance.

- B. The University's Representative shall determine if there is available a dedicated exhaust duct within the project area that is not connected to other exhaust ducts for exhaust out the building. This option can be considered if there are no other ducts attached to the exhaust duct, since other systems attached to the main exhaust duct might be pressurized, changing designed exhaust volumes, or creating back flushing of air in other connected ducts. Use of this option shall be reviewed and approved by University Plant Operations & Maintenance.
- C. 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.
- D. If negative air exhaust is required to be exhausted through a fire-rated assembly, the air shall be directed through approved fire-rated temporary containment systems that meet ASTM E84, Class A requirements for smoke and fire.
- E. When the air from the negative air units is 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.
- F. 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.
- G. Dual HEPA Units operating in parallel may be required for redundancy in high-risk areas.
- H. DOP testing of HEPA equipment
 - 1. Negative air units and HEPA filtered vacuums are to be challenge tested onsite by the DOP test method by a third party prior to being placed in service, after a HEPA filter change, when dropped or damaged or moved from the project site. Only HEPA systems that pass the challenge DOP testing can be used on the project.

All HEPA equipment shall be tested per ANSI/ASME N510 Section 10 to ensure 99.97% efficiency at 0.3 micrometer mean aerodynamic diameter.

2. The entire piece of HEPA equipment shall be challenge tested, not just the filter media. The University's Consultant or EH&S shall witness the HEPA challenge testing procedure in entirety. Once the HEPA system passes the challenge testing and passes, the HEPA equipment may be used at the location tested for a period not to exceed one year. The testing label shall remain on the HEPA equipment and remain legible. Re-testing of the HEPA equipment is required annually, if the piece of equipment is transported out of the building to another building location on the campus, if dropped, or otherwise subjected to forces that might unseat the HEPA filter, damaged by water or laceration of the filter or if HEPA filter maintenance or adjustments are performed.
3. When utilizing HEPA Filtered Vacuums for glove boxes or shrouded tools these HEPA Vacuums must be DOP tested.

3.04 NEGATIVE AIR MONITORING CRITERIA

A. Fully Monitored Negative Air Maintaining -0.020" Water Column (in-WC)

1. Build containment with negative air machines capable of maintaining a pressure differential of -0.020 in-WC across all critical barriers
2. Demonstrate negative pressure is achieved continuously (24/7) by means of an electronic manometer sensitive to measure down to -0.020" wp. The manometer shall be capable of measuring the water pressure down to at least -0.001" in-WC.
3. 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.
4. Inclined manometers using a liquid water solution and non-digital air pressure gauges are not an acceptable manometer since they do not meet the sensitivity of measuring -0.001" WC.
5. Zero pressure or positive pressure is unacceptable and must be responded to immediately. Locate and repair holes or breaches in exterior containment system with tape. Secure zip poles if they have fallen. Close entry door by zipping lower or closing flaps and securing.

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

PROJECT NO. #####
PROJECT TITLE
PROJECT SUBTITLE

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.

3.05 ADDITIONAL CONTAINMENT CRITERIA

A. Ante Room

1. An ante room is a separate chamber attached to the containment area with zippered doors to allow entry and exit into the containment area. Entry into the containment area shall be only via the ante room. The ante room is commonly constructed of zip poles or equivalent, plastic and tape. The ante room is sized for each project to allow workers and equipment to be moved into and out of the containment area. A sticky mat is required in the ante room for workers and carts on wheels to use when exiting the ante room from the containment area. The zippered doors are to remain closed or adjusted slightly open as necessary to allow negative pressure to be maintained at a minimum of -0.020 in-WC during work periods and during off hours.
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.
3. All people who enter and leave the project containment area including the contractor and all subcontractor employees are responsible for removing a dirty sticky mat and replacing it with a clean one when it is necessary. This includes all University Representatives, Consultants, Infection Prevention, Inspector of Record, Environmental Health & Safety, Engineers, Architects, etc.
4. People 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 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. Disposable coveralls are required to protect the patients and are considered Patient Protective Apparel (PPA), since they are designed to protect patients who might be susceptible to the dust generating activity of the construction area.

2. Coveralls are not necessarily considered personal protective equipment (PPE), which is designed to protect the worker, unless the work activity involves asbestos, lead or other chemicals involved in the construction area.
3. Proper use of the disposable coveralls, booties and use of the sticky mat shall be followed at all times for all workers and UC Davis Health 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 University's Representative forty-eight (48) hours prior to containment set up.
- B. Build containment in compliance with ICRA, drawings and plans.
- C. Notify University's 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 University's Environmental Health & Safety Personnel, or by a designated representative of the University. 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. Use an appropriate attachment to ensure all large dust is removed. Vacuum slowly and pay special attention to cracks and crevices where dust may have accumulated.
- C. Prepare a measured solution of a University approved Environmental Protection Agency listed disinfectant and use according to the instructions on the label. Using clean towels or sponges, wipe all surfaces with the disinfectant. If visible dust accumulates on the applicator, wipe again until no residue is detected. Frequently change to clean applicators. Leave the surface wet and allow to air dry. Do not wipe dry.
- D. Remove the top floor layer, if present and HEPA vacuum and wipe down the bottom floor layer. The inspection will not be performed until the containment is dry.
- E. Additional HEPA filtered negative air units may be installed for scrubbing of particles (see 3.05 B).
- F. Coordinate with the University's 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.

- G. 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.
- H. The University's Representative is required to provide a 24-hour notification to University Environmental Services that terminal cleaning will be needed, in addition to notification at the time the containment is being removed. Note that containment removal cannot take place until the Contractor has completed a full cleaning of the containment and the final visual inspection has passed.

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 anteroom 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.

3.10 Refer to the following Attachments

- A. Infection Control Risk Assessment (ICRA) with Matrix of Precautions for Construction & Renovation: 3 Pages.
- B. Infection Control Construction Permit: 1 Page.
- C. UCDH Construction Dust & Hazardous Materials Inspection Worksheet: 1 Page.
- D. ICRA Permit Extension Request and Instructions: 2 Pages.

- E. UC Davis Health Construction Dust Infection Prevention Best Practice Standard: 23 Pages including.
1. Appendix A: Inspection Documentation Form and Daily Inspection Log.
 2. Appendix B: Entry Warning Sign with Project Manager Contact.
 3. Appendix C: Staff Education Poster.

END OF SECTION 01 56 10

BASIC PROJECT INFORMATION			
Project Name:	Project Number:	Today's Date	
Impacted Department(s):	Building Number and Name:	Floor:	Suite/Room:
Estimated Construction Start Date:		Estimated Completion Date:	
UCDH Project Manager:	UCDH PM Mobile Phone #:	UCDH PM Email:	
Construction Manager:	CM Mobile Phone:	CM Mobile Email:	
GENERAL PROJECT SCOPE			
ATTACH DESCRIPTIVE PROJECT SCHEMATIC OR IMAGE TO PACKET			
MULTIDISCIPLINARY TEAM			
Identify the multidisciplinary team that was included in the review of this packet and agree with the requirements identified within the packet.			
Department	Name	Email	
UCDH Project Manager			
Fire Marshal's Office			
Infection Prevention			
Environmental Health & Safety			
Contractor Representative			
Other Multidisciplinary Team Members			

INFECTION CONTROL RISK ASSESSMENT

Step One: Using the table, identify the Construction Project Activity Type (A-E).

Type A ☐	Inspection and non-invasive activities. Includes but is not limited to: • Removal of ceiling tile for visual inspection-limited to 1 tile per 50 square feet with limited exposure time. • Limited building system maintenance (e.g., pneumatic tube station, HVAC system, fire suppression system, electrical and carpentry work to include painting without sanding) that does not create dust or debris. • Clean plumbing activity limited in nature.
Type B ☐	Small-scale, short duration activities that create minimal dust and debris. Includes but is not limited to: • Work conducted above the ceiling (e.g., prolonged inspection or repair of firewalls and barriers, installation of conduit and/or cabling, and access to mechanical and/or electrical chase spaces). • Fan shutdown/startup. • Installation of electrical devices or new flooring that produces minimal dust and debris. • The removal of drywall where minimal dust and debris is created. • Controlled sanding activities (e.g., wet or dry sanding) that produce minimal dust and debris.
Type C ☐	Large-scale, longer duration activities that create a moderate amount of dust and debris. Includes but is not limited to: • Removal of preexisting floor covering, walls, casework or other building components. • New drywall placement. • Renovation work in a single room. • Nonexistent cable pathway or invasive electrical work above ceilings. • The removal of drywall where a moderate amount of dust and debris is created. • Dry sanding where a moderate amount of dust and debris is created. • Work creating significant vibration and/or noise. • Any activity that cannot be completed in a single work shift.
Type D ☐	Major demolition and construction activities. Includes but is not limited to: • Removal or replacement of building system component(s). • Removal/installation of drywall partitions. • Invasive large-scale new building construction. • Renovation work in two or more rooms.
Type E ☐	Exterior Construction typical activities. include, but are not limited to: • Excavation, Trenching, Grading, Boring, Pile Driving, Demolition • Asphalt, Concrete, Stucco, Scaffolding • Roofing • Window washing, Caulking, Tuckpointing, Cleaning, Painting • Landscaping, Planting

Explain this Reasoning for this Assessment:

Step Two: Using the table below, identify the Patient Risk Group(s) that will be affected. If more than one risk group will be affected, select the higher risk group.

Low Risk Non-patient care areas such as:	Medium Risk Patient care support areas such as:	High Risk Patient care areas such as:	Highest Risk Procedural, invasive, sterile support and highly compromised patient care areas such as:
☐ Office areas not on clinical units ☐ Breakrooms not on clinical units ☐ Bathrooms or locker rooms not on clinical units ☐ Mechanical rooms not on clinical units ☐ EVS closets not on clinical units ☐ Corridors and gathering areas not near clinical units	☐ Waiting / Lobby areas ☐ Clinical engineering ☐ Materials management ☐ Sterile processing department - dirty side ☐ Cafeteria, gift shop, coffee shop, and food kiosks ☐ Public hallways and gathering areas near clinical units	☐ Patient care rooms and areas ☐ All acute care units ☐ Emergency department ☐ Employee health ☐ Pharmacy: General Work Zone ☐ Medication rooms and clean utility rooms ☐ Imaging suites: diagnostic imaging ☐ Laboratory ☐ Kitchen	☐ All transplant and intensive care units ☐ All oncology units and other areas with severely immunocompromised patients ☐ OR theaters and restricted areas ☐ Procedural suites ☐ Pharmacy compounding ☐ Sterile processing department: Clean side ☐ Transfusion services ☐ Dedicated isolation units and isolation rooms ☐ Imaging suites: invasive imaging ☐ Dialysis unit

Describe key patient risks:

Step Three: Match the Patient Risk Group (*Low, Medium, High, Highest*) from Step Two with the planned Construction Activity Project Type (*A, B, C, D, E*) from Step One using the table below to find the Class of Precautions (*I, II, III, IV or V*) or level of infection control activities required. The activities are listed in the table below – Minimum Required Infection Control Precautions by Class.

	Construction Project Activity Type				
Patient Risk Group	TYPE A	TYPE B	TYPE C	TYPE D	TYPE E
LOW Risk	☐ I	☐ II	☐ II	☐ III*	☐ Exterior
MEDIUM Risk	☐ I	☐ II	☐ III*	☐ IV	
HIGH Risk	☐ I	☐ III	☐ IV	☐ V	
HIGHEST Risk	☐ III	☐ IV	☐ V	☐ V	

All construction and maintenance activities as defined in Step 1 require a permit and approval unless the work does not expose patients or employees and the ICRA Committee determines there is no appreciable risk to patients for acquired infection due to the project. Such decisions must be documented.

Environmental conditions that could affect human health, such as sewage, Mold, asbestos, gray water, and black water will require Class of Precautions IV for LOW and MEDIUM Risk Groups and Class of Precautions V for HIGH and HIGHEST Risk Groups.

Class III* Precautions - Type C [Medium Risk groups] and Type D [Low Risk Groups] work areas that cannot be sealed and completely isolated from occupied patient care spaces should be elevated to include negative air exhaust requirements as listed in Class IV Precautions.

Surrounding Area Assessment

Step Four: Assess potential risk to areas surrounding the project. Using the table below, identify the surrounding areas that will impact that will occur. If more than one risk group is impacted, select the higher risk group using Step 2 - Patient Risk Group.

Unit Location:	Below	Above	Lateral	Behind
Unit Name:				
Risk Group:				
Unit Contact:				
Phone:				
Email:				
Additional Controls:	☐ Noise ☐ Vibration ☐ Dust control ☐ Ventilation ☐ Pressurization	☐ Noise ☐ Vibration ☐ Dust control ☐ Ventilation ☐ Pressurization	☐ Noise ☐ Vibration ☐ Dust control ☐ Ventilation ☐ Pressurization	☐ Noise ☐ Vibration ☐ Dust control ☐ Ventilation ☐ Pressurization
Impact on other systems, such as:	☐ Data ☐ Mechanical ☐ Med Gases ☐ Water Systems	☐ Data ☐ Mechanical ☐ Med Gases ☐ Water Systems	☐ Data ☐ Mechanical ☐ Med Gases ☐ Water Systems	☐ Data ☐ Mechanical ☐ Med Gases ☐ Water Systems
Notes:				

Were there discoveries in surrounding areas that would serve as cause to increase the class of precautions and necessitate additional precautions? Summarize.

NOISE AND VIBRATION ASSESSMENT

Type	Suggested Control Measures
☐ Drilling ☐ Heavy Equipment ☐ Motors ☐ Pounding ☐ Grinding ☐ Other: Click or tap here to enter text.	☐ Required for high-impact activities – Notify PO&M, Building Coordinator and EH&S ☐ Always consider using Engineering solutions before using Personal Protective Equipment. ☐ Coordinate disruption plan with PO&M and other stakeholders as necessary ☐ Deploy noise dampening blankets or other similar equipment ☐ Use tools or alternative methods designed to minimize noise and vibrations ☐ Use diamond drills instead of powder-actuated fasteners ☐ Use beam clamps instead of shot ☐ Prefab where possible ☐ Use tin snips to cut metal studs instead of using a chop saw ☐ Install metal decking with vent tabs, then use cellular floor deck hangers ☐ Consider pro-press instead of soldering, brazing, or welding ☐ Wet core drill instead of dry core or percussion ☐ Instead of jackhammering concrete, use wet diamond saws ☐ Use HEPA vacuums instead of standard wet/dry vacuums ☐ Use mechanical joining system sprinkler fittings instead of threaded ☐ Where fumes are tolerated, use chemical adhesive remover instead of mechanical ☐ To remove flooring, shot blast instead of using a floor scraper ☐ Use electric sheers instead of reciprocating saw for ductwork cutting. ☐ Install exterior man/material lifts. ☐ Provide staff and/or patients with noise-reducing protective equipment (e.g., ear plugs) ☐ Relocate members/staff to another area of the facility for the duration of the activity ☐ Notify affected areas before noise or vibration-producing activity ☐ Schedule activities during hours that minimize patient, visitor, and staff impact. Hours: Click or tap here to enter text. ☐ Other: Click or tap here to enter text.

AIR QUALITY IMPACT

Type	Suggested Control Measures
☐ Dust ☐ Chemical (VOC) ☐ Fugitive Emissions (Fumes) ☐ Potential Mold Note: If Mold is encountered, follow work practices outlined in the General Requirements Division 1 Section 01561 Document. ☐ Asbestos ☐ Paint Solvent/Cleaner ☐ Roofing Tar ☐ Other: Click or tap here to enter text.	☐ Restrict/shut down air handlers for the duration of activity ☐ Install temporary partitions ☐ Install charcoal filters in HVAC or portable units ☐ Install temporary ductwork and portable units ☐ Prohibit idling of heavy equipment engines ☐ Provide local exhaust ventilation ☐ Substitute material with low VOC product ☐ Notify area staff and EH&S before construction activity that may impact air quality ☐ Provide negative pressure/HEPA filtration ☐ Exhaust HEPA–99.97% to exterior ☐ Relocate members/staff to another area of the facility for the duration of the activity ☐ Schedule activities during hours that minimize patient, visitor, and staff impact. Hours: Click or tap here to enter text. ☐ Provide Safety Data Sheets to EH&S for other recommended actions ☐ Other: Click or tap here to enter text.

HAZARDOUS MATERIALS

A determination regarding the presence of hazardous materials in all UCDH buildings must be made before a project starts. This can be accomplished by existing surveys that identify the presence of hazardous materials or by hiring a consultant to perform a hazardous materials assessment of the areas that the project will impact. All impacted Hazardous Materials must be handled per the appropriate control measures.

Note: A Certified Asbestos Consultant must have conducted an asbestos survey before any demolition or renovation activity. There are no exceptions based on the date of construction or the facility's age.

ACKNOWLEDGEMENT OF HAZARDOUS MATERIALS

Does the project contact hazardous materials (e.g., asbestos, lead, mold, PCBs, mercury)?		☐ Yes	☐ No
How was this verified?	☐ Hazmat Survey	☐ Personal Knowledge	
	☐ Other:		
Who verified this information?	☐ Company:		
	☐ Person and Department:		
	☐ Other:		
Hazardous Materials Present in Project Work Area	Required Control Measures		
☐ Asbestos ☐ Lead ☐ PCBs ☐ Universal Waste ☐ Other: Click or tap here to enter text.	Follow work practices outlined in the General Requirements Division 1 Document.		

CONTAINMENT REQUIREMENTS WORKSHEET

Containment Barrier	Where construction will impact fire-rated assemblies, the contractor is responsible for constructing interim assemblies and barriers that maintain the integrity of the structure's fire-rated system. Note: Interim Life Safety Measures may be required.			
	☐ Full Containment (poly over all surfaces within containment)			
	☐ The ceiling plenum within the work area shall be isolated and sealed by fire-rated six mil. poly			
	☐ Hard Barriers are recommended for work lasting greater than 30 days and in high-traffic areas.			
	☐ Fire retardant plastic barriers are recommended for work lasting less than 30 days. Plastic Barriers cannot be used where hot work will be performed.			
	☐ Isolated Room – Critical Openings Only (seal doors, supply and return registers, etc.)			
	☐ Prefabricated Containment Cube (only large enough for 1-2 people; aka pop-up cube or Mini Cube)			
	☐ Shrouded Tool with HEPA filtered exhaust			
	☐ Glove Box Containment with HEPA filtered exhaust			
☐ Other:				
Negative Pressure	The contractor is required to maintain and document negative air pressure. DOP Tested HEPA-filtered negative air machines (with a minimum of 99.97% efficiency) and a rating of 200 to 2000 cubic feet per minute (CFM) is required for construction activities.			
	☐ -0.020" WC always displayed on a mounted digital manometer			
	☐ -0.020" WC at setup with negative pressure throughout the project as displayed on the manometer			
	☐ Visual Verification of some negative room pressure throughout the project			
	☐ No negative room pressure required			
	☐ Negative pressure in localized HEPA exhausted work area (e.g., shrouded tool, glove box)			
	☐ Additional Ante room under negative pressure			
☐ Other:				
Air Exhaust	☐ Air exhausted directly outside - Avoid exhausting air near air intakes or operable windows doors, and avoid exhausting air near walkways			
	☐ For air exhausted inside, check any of the following conditions that are required:			
	☐ Additional Filtration (ex. Charcoal, Diffuser system)			
	☐ Exhaust into Ducts/HVAC system – Mechanical engineer must confirm that exhausted air will not negatively impact the air balance of the existing system			
	☐ Onsite Challenge Testing (DOP or particle counting) before containment setup			
☐ Challenge Tested within last six months; Equipment has remained onsite at UCDH				
Additional Containment Requirements	☐ Ante Room	☐ Masonite Floor Protection	☐ Protective Clothing	☐ Air Scrubber
	☐ Walk Off Mats	☐ Shoe Covers	☐ Collect Samples During Work	☐ HEPA Vacuum
	☐ Other:			
Verification of Work	☐ HEPA Equipment Verification		☐ EH&S ☐ Consultant ☐ Other:	
	☐ Pre-Work Approval Inspection		☐ PM ☐ EH&S ☐ Consultant ☐ IOR ☐ Other:	
	☐ Daily Onsite Oversight		☐ PM ☐ EH&S ☐ Consultant ☐ IOR ☐ Other:	
	☐ Post Demolition/Abatement Inspection		☐ PM ☐ EH&S ☐ Consultant ☐ IOR ☐ Other:	
	☐ ICRA Downgrade		☐ PM ☐ EH&S ☐ Consultant ☐ IOR ☐ Other:	
	☐ Final Visual Containment Inspection		☐ PM ☐ EH&S ☐ Consultant ☐ IOR ☐ Other:	
	☐ Air Sampling		☐ EH&S ☐ Consultant ☐ Other:	
Air Sampling	☐ Particle Counting ☐ Mold ☐ Asbestos ☐ Other:			Frequency:
Air Balance in Adjacent Areas:	The contractor is responsible for maintaining air balance in adjacent <u>high and highest-risk areas</u> per design/ASHRAE guidelines. Contact PO&M to verify the air balance requirements of surrounding areas.			
	Adjacent High/Highest Risk Areas		Air Balance Requirements	
			Positive/negative pulldown	

		Positive/negative pulldown
ICRA Permit Number		ICRA Class
23-00001		Choose an item.

Project Number:		Project Name:	
Impacted Department:	Building Number and Name:	Floor:	Suite/Room:
UCDH Project Manager:	UCDH PM Mobile Phone #:	UCDH PM Email:	
Construction Manager:	CM Mobile Phone:	CM Mobile Email:	
General Contractor:	General Contractor Mobile Phone:	General Contractor Mobile Email:	
Containment will be set up and maintained by:		Third-Party Containment Consultant:	

ICRA Class Choose an item.		Project Start Date	Completion Date
Additional Requirements			
Signatures	Project Manager	General Contractor	Infection Control and Prevention
Downgrade Request – ICRA Class Choose an item.		Project Start Date	Completion Date
Additional Requirements			
Signatures	Project Manager	General Contractor	Infection Control and Prevention
Extension Request – ICRA Class Choose an item.		Project Start Date	Completion Date
Additional Requirements			
Signatures	Project Manager	General Contractor	Infection Control and Prevention

INFECTION PREVENTION REQUIREMENTS - CLASS I

Prior to and During Construction:	• Perform noninvasive work activity as to not block or interrupt patient care. • Perform noninvasive work activities in areas that are not directly occupied with patients. • Perform noninvasive work activity in a manner that does not create dust. • Immediately replace any displaced ceiling tile before leaving the area and/or at end of noninvasive work activity.
Upon Completion of Work:	Cleaning • Clean work areas including all environmental surfaces, high horizontal surfaces and flooring materials. • Check all supply and return air registers for dust accumulation on upper surfaces as well as air diffuser surfaces. HVAC Systems • Remove isolation of HVAC system in areas where work is being performed. Verify that HVAC systems are clean and operational. • Verify the HVAC systems meet original airflow and air exchange design specifications.
	Additional Infection Prevention Requirements:

INFECTION PREVENTION REQUIREMENTS - CLASS II

Prior to and During Construction:	• Perform only limited dust work and/or activities designed for basic facilities and engineering work. • Perform limited dust and invasive work following standing precautions procedures approved by the organization. • This Class of Precautions must never be used for construction or renovation activities.
Upon Completion of Work:	Cleaning: • Clean work areas including all environmental surfaces, high horizontal surfaces, and flooring materials. • Check all supply and return air registers for dust accumulation on upper surfaces as well as air diffuser surfaces. HVAC Systems: • Remove isolation of the HVAC system in areas where work is being performed. Verify that HVAC systems are clean and operational. • Verify the HVAC systems meet original airflow and air exchange design specifications.
	Additional Infection Prevention Requirements:

INFECTION PREVENTION REQUIREMENTS - CLASS III

Prior to and During Construction:	• Provide active means to prevent airborne dust dispersion into the occupied areas. • Means for controlling minimal dust dispersion may include hand-held HEPA vacuum devices, polyethylene plastic containment, or isolation of work area by closing room door. • Remove or isolate return air diffusers to avoid dust from entering the HVAC system. • Remove or isolate the supply air diffusers to avoid positive pressurization of the space, • If work area is contained, then it must be neutrally to negatively pressurized at all times. *If negative pressure is required, see additional requirements below. • Seal all doors with tape that will not leave residue • Contain all trash and debris in the work area. • Nonporous/smooth and cleanable containers (with a hard lid) must be used to transport trash and debris from the construction areas. These containers must be damp-wiped cleaned and free of visible dust/debris before leaving the contained work area. • Install a sticky (dust collection) mat at entrance of contained work area based on facility policy. Sticky mats must be changed routinely and when visibly soiled. • Maintain clean surroundings when area is not contained by damp mopping or HEPA vacuuming surfaces. Additional requirements for Class III containments that require negative pressure: • Maintain negative pressurization of the entire workspace by use of HEPA exhaust air systems directed outdoors. Exhaust discharged directly to the outdoors that is 25 feet or greater from entrances, air intakes and windows requires the highest degree of filtration feasible. • If exhaust is directed indoors, then the system must be HEPA filtered. Prior to start of work, HEPA filtration must be verified by particulate measurement as no less than 99.97% efficiency and must not alter or change airflow/pressure relationships in other areas. • Exhaust into shared or recirculating HVAC systems, or other shared exhaust systems (e.g., bathroom exhaust) is not acceptable. • Install digital monitoring manometer with one thousandth of inch of water pressure (eg. - 0.024) exterior of work containment to continually monitor negative pressurization. The non-digital manometer monitors are not acceptable.
Upon Completion of Work:	Cleaning: • Clean work areas including all environmental surfaces, high horizontal surfaces, and flooring materials. • Check all supply and return air registers for dust accumulation on upper surfaces as well as air diffuser surfaces. HVAC Systems: • Remove isolation of the HVAC system in areas where work is being performed. Verify that HVAC systems are clean and operational. • Verify the HVAC systems meet original airflow and air exchange design specifications. Class III precautions require inspection and documentation for downgraded ICRA precautions. Construction areas must be inspected by the designee on the containment requirements worksheet for discontinuation or downgrading of ICRA precautions. Work Area Cleaning:

	• Clean work areas including all environmental surfaces, high horizontal surfaces and flooring materials. • Check all supply and return air registers for dust accumulation on upper surfaces as well as air diffuser surfaces. Removal of Critical Barriers: • Critical barriers must remain in place during all work involving drywall removal, creation of dust and activities beyond simple touch-up work. The barrier may NOT be removed until a work area cleaning has been performed. • All (plastic or hard) barrier removal activities must be completed in a manner that prevents dust release. Use the following precautions when removing hard barriers: ○ Carefully remove screws and painter tape. ○ If dust will be generated during screw removal, use hand-held HEPA vacuum. ○ Drywall cutting is prohibited during removal process. ○ Clean all stud tracks with HEPA vacuum before removing outer hard barrier. ○ Use a plastic barrier to enclose area if dust could be generated. Negative Air Requirements: • The use of negative air must be designed to remove contaminants from the work area. • Negative air devices must remain operational at all times and in place for a period after completion of dust creating activities to remove contaminants from the work area and before removal of critical barriers. HVAC systems: • Upon removal of critical barriers, remove isolation of HVAC system in areas where work is being performed. • Verify that HVAC systems are clean and operational. • Verify the HVAC systems meets original airflow and air exchange design specifications.
	Additional Infection Prevention Requirements:

INFECTION PREVENTION REQUIREMENTS - CLASS IV

Prior to and During Construction:

- Construct and complete critical barriers meeting NFPA 241 requirements. Barriers must extend to the ceiling or if ceiling tile is removed, to the deck above.
- All (plastic or hard) barrier construction activities must be completed in a manner that prevents dust release. Plastic barriers must be effectively affixed to ground and ceiling and secure from movement or damage. Apply tape that will not leave a residue to seal gaps between barriers, ceiling or floor.
- Seal all penetrations in containment barriers, including floors and ceiling, using approved materials (UL schedule firestop if applicable for barrier type).
- Containment units or environmental containment units (ECUs) approved for Class IV precautions in small areas totally contained by the unit and that has HEPA-filtered exhaust air (MiniCube Mobile Containments).
- Remove or isolate return air diffusers to avoid dust entering the HVAC system.
- Remove or isolate the supply air diffusers to avoid positive pressurization of the space.
- Negative airflow pattern must be maintained from the entry point to the anteroom and into the construction area. The airflow must cascade from outside to inside the construction area. The entire construction area must remain negatively pressurized.
- Maintain negative pressurization of the entire workspace by use of HEPA exhaust air systems directed outdoors. Exhaust discharged directly to the outdoors that is 25 feet or greater from entrances, air intakes and windows requires the highest degree of filtration feasible.
- If exhaust is directed indoors, then the system must be HEPA filtered. Prior to start of work, HEPA filtration must be verified by particulate measurement as no less than 99.97% efficiency and must not alter or change airflow/pressure relationships in other areas.
- Exhaust into shared or recirculating HVAC systems, or other shared exhaust systems (e.g., bathroom exhaust) is not acceptable.
- Install digital monitoring manometer with one thousandth of inch of water pressure (eg. - 0.024) exterior of work containment to continually monitor negative pressurization. The non-digital manometer monitors are not acceptable.
- Contain all trash and debris in the work area.
- Nonporous/smooth and cleanable containers (with a hard lid) must be used to transport trash and debris from the construction areas. These containers must be damp-wiped cleaned and free of visible dust/debris before leaving the contained work area.
- Worker clothing must be clean and free of visible dust before leaving the work area. HEPA vacuuming of clothing or use of cover suites is acceptable.
- Workers must wear shoe covers prior to entry into the work area. Shoe covers must be changed prior to exiting the anteroom to the occupied space (non-work area). Damaged shoe covers must be immediately changed.
- Install a sticky (dust collection) mat at entrance of contained work area based on facility policy. Sticky mats must be changed routinely and when visibly soiled.
- Collection of particulate data during work may be collected to assure that contaminants do not enter the occupied spaces. Routine collection of particulate samples may be used to verify HEPA filtration efficiencies. Collection of particulate data may be collected by Environmental Health and Safety or approved third party consultant.

Upon Completion of Work:	Class IV precautions require inspection and documentation for downgraded ICRA precautions. Construction areas must be inspected by the designee on the containment requirements worksheet for discontinuation or downgrading of ICRA precautions. Work Area Cleaning: • Clean work areas including all environmental surfaces, high horizontal surfaces and flooring materials. • Check all supply and return air registers for dust accumulation on upper surfaces as well as air diffuser surfaces. Removal of Critical Barriers: • Critical barriers must remain in place during all work involving drywall removal, creation of dust and activities beyond simple touch-up work. The barrier may NOT be removed until a work area cleaning has been performed. • All (plastic or hard) barrier removal activities must be completed in a manner that prevents dust release. Use the following precautions when removing hard barriers: ○ Carefully remove screws and painter tape. ○ If dust will be generated during screw removal, use hand-held HEPA vacuum. ○ Drywall cutting is prohibited during removal process. ○ Clean all stud tracks with HEPA vacuum before removing outer hard barrier. ○ Use a plastic barrier to enclose area if dust could be generated. Negative Air Requirements: • The use of negative air must be designed to remove contaminants from the work area. • Negative air devices must remain operational at all times and in place for a period after completion of dust creating activities to remove contaminants from the work area and before removal of critical barriers. HVAC systems: • Upon removal of critical barriers, remove isolation of HVAC system in areas where work is being performed. • Verify that HVAC systems are clean and operational. • Verify the HVAC systems meets original airflow and air exchange design specifications.
	Additional Infection Prevention Requirements:

INFECTION PREVENTION REQUIREMENTS - CLASS V

Prior to and During Construction:

- Construct and complete critical barriers meeting NFPA 241 requirements. Barriers must extend to the ceiling or if ceiling tile is removed, to the deck above.
- All (plastic or hard) barrier construction activities must be completed in a manner that prevents dust release. Plastic barriers must be effectively affixed to ground and ceiling and secure from movement or damage. Apply tape that will not leave a residue to seal gaps between barriers, ceiling or floor.
- Seal all penetrations in containment barriers, anteroom barriers, including floors and ceiling using approved materials (UL schedule firestop if applicable for barrier type).
- Construct anteroom large enough for equipment staging, cart cleaning, workers. The anteroom must be constructed adjacent to entrance of construction work area.
- Personnel will be required to wear coveralls at all times during Class V work activities. Coveralls must be removed before leaving the anteroom.
- Remove or isolate return air diffusers to avoid dust entering the HVAC system.
- Remove or isolate the supply air diffusers to avoid positive pressurization of the space.
- Negative airflow pattern must be maintained from the entry point to the anteroom and into the construction area. The airflow must cascade from outside to inside the construction area. The entire construction area must remain negatively pressurized.
- Maintain negative pressurization of the entire workspace by use of HEPA exhaust air systems directed outdoors. Exhaust discharged directly to the outdoors that is 25 feet or greater from entrances, air intakes and windows requires the highest degree of filtration feasible
- If exhaust is directed indoors, then the system must be HEPA filtered. Prior to start of work, HEPA filtration must be verified by particulate measurement as no less than 99.97% efficiency and must not alter or change airflow/pressure relationships in other areas.
- Exhaust into shared or recirculating HVAC systems, or other shared exhaust systems (bathroom exhaust) is not acceptable.
- Install digital monitoring manometer with one thousandth of inch of water pressure (eg. -0.024) exterior of work containment to continually monitor negative pressurization. The non-digital manometer monitors are not acceptable.
- Contain all trash and debris in the work area.
- Nonporous/smooth and cleanable containers (with a hard lid) must be used to transport trash and debris from the construction areas. These containers must be damp-wiped cleaned and free of visible dust/debris before leaving the contained work area.
- Worker clothing must be clean and free of visible dust before leaving the work area anteroom.
- Workers must wear shoe covers prior to entry into the work area. Shoe covers must be changed prior to exiting the anteroom to the occupied space (non-work area). Damaged shoe covers must be immediately changed.
- Install a sticky (dust collection) mat at entrance of contained work area based on facility policy. Sticky mats must be changed routinely and when visibly soiled.
- Collection of particulate data during work may be collected to assure that contaminants do not enter the occupied spaces. Routine collection of particulate samples may be used to verify HEPA filtration efficiencies. Collection of particulate data may be collected by Environmental Health and Safety or approved third party consultant.

Class IV precautions require inspection and documentation for downgraded ICRA precautions.

Construction areas must be inspected by the designee on the containment requirements worksheet for discontinuation or downgrading of ICRA precautions.

Work Area Cleaning:

- Clean work areas including all environmental surfaces, high horizontal surfaces and flooring materials.
- Check all supply and return air registers for dust accumulation on upper surfaces as well as air diffuser surfaces.

Removal of Critical Barriers:

- Critical barriers must remain in place during all work involving drywall removal, creation of dust and activities beyond simple touch-up work. The barrier may NOT be removed until a work area cleaning has been performed.
- All (plastic or hard) barrier removal activities must be completed in a manner that prevents dust release. Use the following precautions when removing hard barriers:
 - Carefully remove screws and painter tape.
 - If dust will be generated during screw removal, use hand-held HEPA vacuum.
 - Drywall cutting is prohibited during removal process.
 - Clean all stud tracks with HEPA vacuum before removing outer hard barrier.
 - Use a plastic barrier to enclose area if dust could be generated.

Negative Air Requirements:

- The use of negative air must be designed to remove contaminants from the work area.
- Negative air devices must remain operational at all times and in place for a period after completion of dust creating activities to remove contaminants from the work area and before removal of critical barriers.

HVAC systems:

- Upon removal of critical barriers, remove isolation of HVAC system in areas where work is being performed.
- Verify that HVAC systems are clean and operational.
- Verify the HVAC systems meets original airflow and air exchange design specifications.

Additional Infection Prevention Requirements:

INFECTION PREVENTION REQUIREMENTS – EXTERIOR

Prior to and During Construction:	• Identify and confirm fugitive fume and dust control measures are in place prior to work starting i.e., charcoal filters at air intakes, scrubbers on equipment etc. • Contractor must submit an excavation and trenching plan for review and implementation. • Install fencing, physical barriers and interior/exterior signage to re-direct pedestrian and vehicular traffic as necessary. • If locally required, validate soil survey was performed to identify potential contaminants (e.g., valley fever, radon, legionellosis, etc.). • Ensure that fugitive dust control measures are adhered to (e.g., work area is kept wet). • Validate those fumes created by equipment and material is controlled. - o If required, install charcoal filters on air intake to building. - o Maintain equipment exhaust scrubbers if working near sensitive areas or near air-intake - o Minimize equipment idling • Validate barriers restricting access and signage into construction work areas are maintained.
Upon Completion of Work:	• Ensure all control measures are removed at completion of project.
	Additional Infection Prevention Requirements:

SECTION 01 56 20

REQUIREMENTS FOR CEILING ACCESS TO SPACES CONTAINING ASBESTOS

PART I - GENERAL

1.01 SECTION INCLUDES

- A. 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.
- B. 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 California Code of Regulations, Title 8, Section 1529. 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 II - Not applicable to this section

PART III - EXECUTION

3.01 Training

- A. 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. This training shall adhere to requirements as set forth in 40 CFR 763.92(a)(2).

3.02 Competent Person

- A. 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. The Competent Person shall adhere to all requirements within their area of responsibility outlined in 8 CCR 1529.

3.03 Standard Access/Egress Procedures from Mini-Enclosure

- A. 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. All mini-enclosures and HEPA vacuums must be re-certified by a third-party using DOP testing every 6 months.

- B. Disposable full body coveralls are required in all ICRA Class III and IV containment areas dealing with asbestos or presumed asbestos 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.
- C. Proper use of the disposable coveralls and use of the sticky mat shall be followed at all times for all workers and University 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 labeled, secured, plastic asbestos waste bag before leaving the mini-enclosure.

3.04 Air Sampling

- A. Air sampling is required per 8 CCR 1529 to assess asbestos exposures when the project requires workers to enter the attic space if there is a reasonable possibility that the permissible exposure limit (PEL) may be exceeded. 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.

3.05 Debris Clean-up

- A. 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. These techniques of minimizing asbestos fiber migration are outlined in 8 CCR 1529 and are to be strictly adhered to.

3.06 Personal Protective Equipment

- A. All personnel entering the attic space with known or presumed asbestos containing materials shall wear full body disposable coveralls (e.g., Tyvek, Kleenguard or equivalent) and at a minimum, a half face, tight fitting, elastomeric respirator with HEPA (P-100) filter cartridges for asbestos protection (or a respirator offering greater protection). The individual wearing this respirator must have been fit tested, trained and had medical clearance, pursuant to 8 CCR 5144.

3.07 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 asbestos will likely not be disturbed).

- A. Control of disturbance of asbestos debris during work inside of an attic space 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:
 - a. dry sweeping is not permitted
 - b. employees must not walk on, crawl on or otherwise crush visible suspect asbestos containing debris
 - c. the control method must not result in a release of airborne fibers.

- B. 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.
- 3.08 HEPA Filter Challenge Testing and Certification
- A. 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 University building.
- 3.09 Access for Inspection after Ceiling Tile has been Removed
- A. 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 which materials in the area contain asbestos.
- 3.10 Asbestos Waste Management
- A. 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 project name, IPA ID No. and address. Information will be provided by University once any asbestos waste management is confirmed.
 - B. For those projects generating five (5) or fewer bags of asbestos-contaminated materials, University 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.
 - C. 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 the University EH&S. Contact EH&S with at least one week's notice of the intent to dispose.

END OF SECTION 01 56 20

SECTION 01 61 00

PRODUCT REQUIREMENTS

PART I - GENERAL

1.01 SECTION INCLUDES

- A. Product Options
- B. Product Substitutions
- C. Product Transportation and Handling Requirements
- D. Product Storage and Protection
- E. Product System Completeness

1.02 RELATED SECTIONS

- A. Section 013300 – SHOP DRAWINGS, PRODUCT DATA AND SAMPLES
- B. Section 013900 - GREEN BUILDING POLICY IMPLEMENTATION
- C. Section 014100 – REGULATORY REQUIREMENTS
- D. Section 014500 – QUALITY CONTROL

1.03 PRODUCTS

- A. Product Selection: Provide products that comply with Contract Documents, are undamaged and unused at installation.
- B. Product Completeness: Provide products complete with all accessories, trim, finish, safety guards and other devices needed for complete installation and for intended use and effect.
- C. Products: Items purchased for incorporation in Work, whether purchased for project or taken from previously purchased stock; this includes materials, equipment, assemblies, fabrications and systems.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model designation indicated in the manufacturer's published product data.
 - 2. Materials: Products that are shaped, cut, worked, mixed, finished, refined, or otherwise fabricated, processed or installed to form part of the Work.
 - 3. Equipment: A product with operating parts, whether motorized or manually operated, requiring connections such as wiring or piping.
- D. Specific Product requirements: Refer to requirements of Section 014500 – QUALITY CONTROL and other Sections in Division 2 through 49 for specific requirements for products.

- E. Code Compliance: All products, other than commodity products prescribed by Code, shall have current listing service report or research report. Minimum Requirements: Specified requirements are minimum requirements.
- F. Interchangeability: To fullest extent possible, provide products of the same kind from single source. Products supplied in quantity shall be same product and interchangeable throughout the Work. When options are specified for selection of any of two (2) or more products, product selected shall be compatible with products previously selected.
- G. Nameplates: Except for required labels and operating data, do not attach manufacturer's name plates or trademarks on surfaces exposed to view in occupied spaces or on the exterior of building.
- H. Equipment Nameplates: Provide permanent nameplate on each item or service-connected or power-operated equipment. Locate on inconspicuous accessible surface. Nameplate shall contain the following information and essential operating data:
 - 1. Name of product and manufacturer
 - 2. Model and serial number
 - 3. Capacity and Speed
 - 4. Ratings and other pertinent information
- I. Listing Service: Products, for which listing service standards have been established and for which their service label is available, shall bear the appropriate listing service label.

1.04 PRODUCT OPTIONS

- A. Products Specified Only by Description: Where the Contract Specifications describe a product, listing characteristics required, with or without use of a brand name, provide a product that provides the appropriate characteristics and otherwise complies with the requirements.
- B. Performance Specification: Where Contract Specifications require compliance with performance requirements, provide products that comply and are recommended for application. Manufacturer's recommendations may be contained in Product literature, or by certification of performance.
- C. Compliance with Standards: Where Contract Specifications require compliance with a standard, select a product that complies with the standard specified.
 - 1. Wherever catalog numbers and specific brands or trade names followed by the designation "to match existing" are used in conjunction with product(s) required by the Contract Specification, no substitution will be considered.

D. Products Specified by Naming One (1) or More Manufacturers:

1. Specified manufacturer(s): Provide specified product(s) of the specified manufacturer. Wherever more than one (1) manufacturer's product is specified, the first-named product is the basis for the design used in the Work and the use of alternative-named products or substitutes may require modifications in that design. If such alternatives are proposed by Contractor and are approved by University, Contractor shall assume all costs required to make necessary revisions and modifications to the design, including additional costs to University for evaluation of revisions and modifications of the design resulting from the substitutions submitted by Contractor.
 - a. When materials and equipment are specified by first manufacturer's name and product number, second manufacturer's name and "or equal" supporting data for second manufacturer's product, if proposed by Contractor, shall be submitted in accordance with the requirements for substitution.
2. Quality Standard: Products(s) of the specified manufacturer shall serve as standard by which the product(s) of other named manufacturers are evaluated.

E. "Or Equal" Provision: Catalog numbers and specific brands or trade names followed by the designation "or equal" are used in conjunction with material and equipment required by Contract Specification to establish standard of quality, utility, and appearance required.

1. "Or Equal" Products: Equivalent products of manufacturers other than the specified manufacturer may be provided if determined by University's Representative to be acceptable in accordance with substitution provisions following:
 - a. Contractor shall submit to University's Representative, within thirty-five (35) calendar days after the date of commencement of the Work specified in the Notice to Proceed, a list in excel format containing Specification Section number with extension i.e. 088000 2.B.1.a. with descriptions of each product proposed for substitution.
 - b. Contractor shall provide supporting data as required herein.
 - c. University will evaluate Contractor's proposal. The decision of University shall be final.
 - d. University will accept, in writing, proposed substitutions that are in University's opinion equal in quality, utility and appearance to the product specified. Such acceptance does not relieve Contractor from complying with requirement of the Contract Documents.

- e. Contractor shall be responsible for all costs of any changes resulting for Contractor's proposed substitutions that affect other work, or the Work of Separate Contractor.
 - f. Failure to place orders for specified products sufficiently in advance of required date for incorporation into the Work will not be considered justification for Contractor to request a substitution or deviation from requirements of the Contract Documents. The sixty (60) calendar day submittal period does not excuse Contractor from completing the Work within the Contract Time.
- 2. Contractor's Determination: Prior to submitting "or equal" product(s) for consideration, Contractor shall review and determine product(s) meet or exceed the quality and warranty provisions of the specified product.
- 3. Late Substitution Requests: If a request for substitution occurs after the sixty (60) calendar day period, the substitution may be reviewed at the discretion of University and the costs of such review, as approved by University, shall be deducted from the Contract Sum.
 - a. Product Availability Waiver: Substitutions will be considered after the sixty (60) calendar day period only when a product becomes unavailable due to no fault of the Contractor.
- F. Visual Matching: Where Contract Specifications require matching a sample, University's decision on proposed product match is final. If no product matches and complies with other requirements, comply with provisions for "substitutions" for selection of a matching product in another category.
- G. Visual Selection: Where requirements include the phrase "...as selected from manufacturer's standard colors, patterns, textures..." or a similar phrase, select a product that complies with other requirements. University's Representative will select color, pattern and texture from the product line selected.

1.05 SUBSTITUTIONS

- A. Substitutions: Requests for changes in products, materials, equipment, and methods of construction required by Contract Documents proposed by the Contractor after award of the Contract shall be considered "substitutions". The following are not considered substitutions:
 - 1. Revisions to Contract Documents requested by University's Representative or University's Consultant.
 - 2. Specified options of products and construction methods included in Contract Documents.
 - 3. Compliance with governing regulations and orders issued by governing authorities.

- B. Substitution Provisions: Requests for Substitutions will only be considered if Contractor submits the following data:
1. Furnish complete technical data including drawings, performance specifications, samples, test reports and any additional information required by University's Representative, for each product proposed for substitution.
 - a. Submit ONE (1) PDF file with bookmarks.
 - b. In reviewing supporting data for substitution, University will use, for purpose of comparison, all characteristics of Basis of Design specified product as it appears in manufacturer's published data even though all characteristics may not have been particularly mentioned in the Contract Specifications. If more than two (2) substitutions of supporting data are required, University's costs of reviewing additional supporting data will be deducted from the Contract Sum.
 - c. Submit statement indicating substitution's effect on the Construction Schedule, if any.
 - d. Submit cost information, including proposal of net deduction, if any, from Contract Sum.
 2. Furnish statement by Contractor that proposed substitution is in full compliance with requirements of Contract Documents and Applicable Codes.
 3. Provide a Comparison Table as part of the substitution request listing the design and performance criteria of the Basis of Design specified product with the proposed substitution product side by side. The design and performance criteria shall include but not limited to; size, thickness, gauge, strength, function, ASTM rating, test report data, manufacturing association standards & data, technical properties & performance data, traffic or weather resistance, quality assurance data, warranty and other design and performance criteria list in Basis of Design manufactures specification and written material.
 4. Furnish list of Subcontractors, if any, that may be affected by the substitution.
 5. If proposed substitution requires portions of the Work to be redesigned or removed in order to accommodate substituted product, submit design and engineering calculations prepared by the licensed design professional of record.
 6. Contract Document Revisions: Should Contractor-proposed or alternate sequence or method of construction require revision of Contract Documents, including revisions for purpose of determining feasibility, scope or cost, or revisions for the purpose of obtaining approval by governing authorities having jurisdiction, revisions will be made by University's Consultant who is the design professional of record.
 - a. Services of University's Consultants, including time spent in researching and reporting on proposed substitutions or alternate sequences and methods of construction, shall be paid by Contractor when such activities are considered additional services to the design services contracts of University.

- b. Cost of services by University's Consultants shall be paid on a time and material basis, based on current hourly fee schedules, with reproduction, long distance telephone and shipping costs reimbursable. Such fees shall be paid whether or not the proposed substitution or alternate sequence or method of construction is ultimately accepted by University and Change Order executed. Such fees owed shall be deducted from the Contract sum on the next Application for Payment.
- 7. Submit all proposed substitutions in writing to University using the Request for Substitution form provided at the back of this Section.
- C. University may reject any substitution not proposed as described above and presented within the time prescribed.
- D. Revisions to submittals: If University's Representative, in reviewing list of substitutions, requires revisions or corrections to previously accepted Shop Drawings and supplemental supporting data, Contractor shall promptly do so. If any proposed substitution is judged by University's Representative to be unacceptable, the specified product shall be provided at no cost to the University.
- E. Samples: Samples may be required. Tests required by University's Representative for determination of quality and utility shall be made by Contractor's independent testing Laboratory, at expense of Contractor, with prior University acceptance of test procedure.

1.06 TRANSPORTATION, DELIVERY AND HANDLING

- A. Transport products by methods to avoid product damage.
- B. Schedule delivery to minimize long-term storage and prevent overcrowding construction spaces. Coordinate with installation to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft and other losses.
- C. Deliver products in undamaged condition in manufacturer's original sealed container or packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
- D. Provide equipment and personnel to handle products by methods to prevent soiling, marring or other damage.
- E. Promptly inspect products on delivery to ensure products comply with Contract Documents, quantities are correct, and to ensure products are undamaged and properly protected. Promptly remove damaged or defective products from site and replace at no adjustment to the Contract Sum and/or Contract Time.

1.07 STORAGE AND PROTECTION

- A. Store products in accordance with manufacturer's instructions, with seals and labels intact and legible.
- B. Store products to facilitate inspection and measurement of quantity or counting of units.
- C. Store heavy materials away from structures in a manner that will not endanger supporting construction.

- D. Store sensitive products in weather-tight enclosures. Store products subject to damage by the elements above ground, under cover in a weather-tight enclosure, with ventilation adequate to prevent condensation.
 - 1. Maintain temperature and humidity within range required by manufacturer's instructions.
 - 2. Exterior Storage:
 - a. Store products above ground on blocking or skids to prevent soiling, staining and damage.
 - b. Cover products that are subject to damage by the elements with impervious protective sheet coverings. Provide adequate ventilation to prevent condensation.
 - c. Store sand, rock, aggregate or other loose granular material in well-drained area on solid surfaces. Prevent mixing with foreign matter.
 - 3. Arrange storage to provide access for inspection. Periodically inspect to assure products are undamaged and maintained under required conditions, free from damage and deterioration.
- E. Protection After Installation: Provide barriers, substantial coverings, notices and other materials or methods as necessary to protect installed work from traffic, subsequent construction operations and weather.
 - 1. Maintain temperature and humidity conditions in interior spaces for Work in accordance with manufacturers' instructions for materials and equipment being protected.
 - 2. Remove protective measures when no longer required and prior to Acceptance of the Work.

1.08 SYSTEM COMPLETENESS

- A. The Contract Drawings and Contract Specification are not intended to be comprehensive directions on how to produce the Work. Rather, the Drawings and Specifications are instruments of service prepared to describe the design intent for the completed Work.
- B. It is intended that equipment, systems and assemblies be complete and fully functional even though not fully described. Provide all products and operations necessary to achieve the design intent described in the Contract Documents.
- C. Contractor is urged to report to University's Representative immediately when elements essential to proper execution of the Work are discovered to be missing or misdescribed in the Contract Documents or if the design intent is unclear.

- D. Should an essential element be discovered as missing or misdescribed prior to receipt of bids or establishing a negotiated Contract Sum, an Addendum or Clarification will be issued so that all cost may be accounted in the Contract Sum.
- E. Should an obvious omission or misdescription of a necessary element be discovered and reported after execution of the Agreement, Contractor shall provide the element as though fully and correctly described.

PART II - PRODUCTS – Not Applicable to this Section

PART III - EXECUTION

3.01 INSTALLATION OF PRODUCTS

- A. Comply with manufacturer's instructions and recommendations for installation of products.
- B. Anchor each product securely in place, accurately located and aligned with other Work. Clean exposed surfaces and protect to ensure freedom from damage and deterioration at time of Substantial Completion.

3.02 Refer to the following Attachment:

- A. Request for Substitution Form.

END OF SECTION 01 61 00

REQUEST FOR SUBSTITUTION

Substitution #: _____ Submittal #: _____ Date: _____

Project#: _____ HCAI#: _____

PROJECT NAME: _____

TO: UC DAVIS HEALTH Facilities Design & Construction 4800 2ND Avenue, Suite 3010 Sacramento, CA95817 P: 916-734-7024 Attn.: (Project Manager's Email Address)	FROM: _____ _____ _____ _____ _____

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 013300 – 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: _____

SECTION 01 61 16
VOLATILE ORGANIC COMPOUND (VOC) CONTENT RESTRICTIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Requirements for VOC-Content-Restricted products.
- B. VOC restrictions for product categories listed below under "DEFINITIONS."
- C. All products of each category that are installed in the project must comply; Owner's project goals do not allow for partial compliance.

1.02 RELATED REQUIREMENTS

- A. Section 01 33 00 - Shop Drawings, Product Data, and Samples: Submittal procedures.
- B. Section 01 39 00 - Green Building Procedures
- C. Section 07 92 00 - Joint Sealants: Emissions-compliant sealants.
- D. Section 01 6116.01 - Accessory Material VOC Content Certification Form.

1.03 DEFINITIONS

- A. VOC-Content-Restricted Products: All products in the following product categories when installed or applied on-site on the building exterior:
 - 1. Exterior and interior paints and coatings.
 - 2. Exterior and interior adhesives and sealants, including flooring adhesives.
 - 3. Wet-applied roofing and waterproofing.
 - 4. Thermal Insulation.
- B. VOC-Content-Restricted Products: All products of each of the following categories when installed or applied on-site in the building interior:
 - 1. Adhesives, sealants, and sealer coatings.
 - 2. Carpet.
 - 3. Carpet cushion.
 - 4. Carpet tile.
 - 5. Resilient floor coverings.
 - 6. Fluid-Applied Flooring and Underlayments.
 - 7. Paints and coatings.

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8. Insulation.
 9. Gypsum board.
 10. Acoustical ceilings and panels.
 11. Cabinet work.
 12. Wall coverings.
 13. Other products when specifically stated in the specifications.
- C. Interior of Building: Anywhere inside the exterior weather barrier.
- D. Adhesives: All gunnable, trowelable, liquid-applied, and aerosol adhesives, whether specified or not; including flooring adhesives, resilient base adhesives, and pipe jointing adhesives.
- E. Sealants: All gunnable, trowelable, and liquid-applied joint sealants and sealant primers, whether specified or not; including firestopping sealants and duct joint sealers.

1.04 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency current edition.
- B. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions From Indoor Sources Using Environmental Chambers 2017, v1.2.
- C. CARB (ATCM) - Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products; California Air Resources Board current edition.
- D. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board 2007.
- E. CHPS (HPPD) - High Performance Products Database Current Edition at www.chps.net/.
- F. GreenSeal GS-36 - Adhesives for Commercial Use 2013.
- G. RFCI Floor Score - FloorScore; Resilient Floor Covering Institute; current certification.
- H. SCAQMD 1113 - Architectural Coatings 1977 (Amended 2016).
- I. SCAQMD 1168 - Adhesive and Sealant Applications 1989 (Amended 2017).
- J. UL (GGG) - GREENGUARD Gold Certified Products Current Edition.

1.05 SUBMITTALS

- A. See Section 01 33 00 - Shop Drawings, Product Data, and Samples, for submittal procedures.

- B. Product Data: For each VOC-content-restricted product used in the project, submit evidence of compliance. Material Safety Data Sheets (MSDS) submitted will only be reviewed for compliance with VOC content restrictions.

PART 2 PRODUCTS

2.01 MATERIALS

- A. All Products: Comply with the most stringent of federal, State, and local requirements, or these specifications.
- B. Wet-Applied Roofing and Waterproofing: Comply with requirements for paints and coatings.
- C. Fluid-Applied Flooring and Underlayments: Comply with requirements for paints and coatings.
- D. Adhesives and Joint Sealants: Provide only products having volatile organic compound (VOC) content not greater than required by **all** of the following:
1. SCAQMD 1168
- E. Aerosol Adhesives: Provide only products having volatile organic compound (VOC) content not greater than required by **all** of the following:
1. GreenSeal GS-36
 2. California Code of Regulations Title 17 (CalGreen 5.504.4.1)
- F. Paints and Coatings: Provide only products having volatile organic compound (VOC) content not greater than required by **all** of the following:
1. Air Resources Board Architectural Coatings Suggested Control Measure
 2. California Code of Regulations Title 17 (CalGreen 5.504.3.1)
 3. 40 CFR 59, Subpart D
 4. SCAQMD 1113
- G. Composite Wood: Provide only products having volatile organic compound (VOC) content not greater than required by **all** of the following:
1. CARB (ATCM)
 2. CalGreen Table 5.504.4.5
- H. Resilient Flooring Systems: Provide only products having volatile organic compound (VOC) content not greater than required by **one** of the following:
1. Resilient Floor Covering Institute (RFCI) FloorScore Certification

2. CAL (CDPH SM)
 3. California Collaborative for High Performance Schools EQ 2.2 and CHPS (HPPD) listed
 4. Greenguard Children & Schools Program Certification
 5. California Code of Regulations Title 17 (CalGreen 5.504.4.4 and 5.504.4.6)
- I. Other Product Categories: Comply with limitations specified elsewhere.

PART 3 EXECUTION

3.01 FIELD QUALITY CONTROL

- A. Owner reserves the right to reject non-compliant products, whether installed or not, and require their removal and replacement with compliant products at no extra cost to Owner.
- B. Additional costs to restore indoor air quality due to installation of non-compliant products will be borne by Contractor.

END OF SECTION

SECTION 01 61 16.01
ACCESSORY MATERIAL VOC CONTENT CERTIFICATION FORM

FORM

1.01 IDENTIFICATION:

- A. Project Name: _____
- B. Project No.: _____
- C. Architect: _____

1.02 USE OF THIS FORM:

- A. Because installers are allowed and directed to choose accessory materials suitable for the applicable installation, there is a possibility that such accessory materials might contain VOC content in excess of that permitted, especially where such materials have not been explicitly specified.
- B. Contractor is required to obtain and submit this form from each installer of work on this project.
- C. For each product category listed, circle the correct words in brackets: either [HAS] or [HAS NOT].
- D. If any of these accessory materials has been used, attach to this form product data and MSDS sheet for each such product.

1.03 VOC CONTENT RESTRICTIONS ARE SPECIFIED IN SECTION 01 61 16.

2.01 PRODUCT CERTIFICATION

- A. I certify that the installation work of my firm on this project:
 - 1. [HAS] [HAS NOT] required the use of any ADHESIVES.
 - 2. [HAS] [HAS NOT] required the use of any JOINT SEALANTS.
 - 3. [HAS] [HAS NOT] required the use of any PAINTS OR COATINGS.
 - 4. [HAS] [HAS NOT] required the use of any COMPOSITE WOOD or AGRIFIBER PRODUCTS.
- B. Product data and MSDS sheets are attached.

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3.01 CERTIFIED BY: (INSTALLER/MANUFACTURER/SUPPLIER FIRM)

A. Firm Name: _____

B. Print Name: _____

C. Signature: _____

D. Title: _____ (officer of company)

E. Date: _____

END OF SECTION

SECTION 01 61 16
VOLATILE ORGANIC COMPOUND (VOC) CONTENT RESTRICTIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Requirements for VOC-Content-Restricted products.
- B. VOC restrictions for product categories listed below under "DEFINITIONS."
- C. All products of each category that are installed in the project must comply; Owner's project goals do not allow for partial compliance.

1.02 RELATED REQUIREMENTS

- A. Section 01 33 00 - Shop Drawings, Product Data, and Samples: Submittal procedures.
- B. Section 01 39 00 - Green Building Procedures
- C. Section 07 92 00 - Joint Sealants: Emissions-compliant sealants.
- D. Section 01 6116.01 - Accessory Material VOC Content Certification Form.

1.03 DEFINITIONS

- A. VOC-Content-Restricted Products: All products in the following product categories when installed or applied on-site on the building exterior:
 - 1. Exterior and interior paints and coatings.
 - 2. Exterior and interior adhesives and sealants, including flooring adhesives.
 - 3. Wet-applied roofing and waterproofing.
 - 4. Thermal Insulation.
- B. VOC-Content-Restricted Products: All products of each of the following categories when installed or applied on-site in the building interior:
 - 1. Adhesives, sealants, and sealer coatings.
 - 2. Carpet.
 - 3. Carpet cushion.
 - 4. Carpet tile.
 - 5. Resilient floor coverings.
 - 6. Fluid-Applied Flooring and Underlayments.
 - 7. Paints and coatings.

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8. Insulation.
 9. Gypsum board.
 10. Acoustical ceilings and panels.
 11. Cabinet work.
 12. Wall coverings.
 13. Other products when specifically stated in the specifications.
- C. Interior of Building: Anywhere inside the exterior weather barrier.
- D. Adhesives: All gunnable, trowelable, liquid-applied, and aerosol adhesives, whether specified or not; including flooring adhesives, resilient base adhesives, and pipe jointing adhesives.
- E. Sealants: All gunnable, trowelable, and liquid-applied joint sealants and sealant primers, whether specified or not; including firestopping sealants and duct joint sealers.

1.04 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency current edition.
- B. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions From Indoor Sources Using Environmental Chambers 2017, v1.2.
- C. CARB (ATCM) - Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products; California Air Resources Board current edition.
- D. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board 2007.
- E. CHPS (HPPD) - High Performance Products Database Current Edition at www.chps.net/.
- F. GreenSeal GS-36 - Adhesives for Commercial Use 2013.
- G. RFCI Floor Score - FloorScore; Resilient Floor Covering Institute; current certification.
- H. SCAQMD 1113 - Architectural Coatings 1977 (Amended 2016).
- I. SCAQMD 1168 - Adhesive and Sealant Applications 1989 (Amended 2017).
- J. UL (GGG) - GREENGUARD Gold Certified Products Current Edition.

1.05 SUBMITTALS

- A. See Section 01 33 00 - Shop Drawings, Product Data, and Samples, for submittal procedures.

SECTION 01 72 00

PREPARATION

PART I - GENERAL

1.01 SECTION INCLUDES

- A. Surveying and Field Engineering Services

1.02 RELATED SECTIONS

- A. Section 014500 – QUALITY CONTROL
- B. Section 017800- CLOSEOUT SUBMITTALS

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. For work that connects to existing structures with new floors or roofs that align with existing conditions; Contractor shall verify new and existing elevations prior to constructing the new

floor or roof structure. Adjust elevations accordingly so that the new and existing floors are level and lineup.

1. University approval in writing is required for any deviations from the contract documents intent.
- D. 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.
- C. All control points established for the project must be clearly shown on the record documents.

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 Including but not limited to items indicated in 3.03, B. and 3.04, B.
- B. On completion of foundation walls, underground utilities and major site improvements, prepare certified survey showing all dimensions, locations, angles and elevations of construction. Provide as part of the As-Built Documents per Section 017800.

END OF SECTION 01 72 00

SECTION 01 73 00

CUTTING AND PATCHING

PART I - GENERAL

1.01 SECTION INCLUDES

- A. Requirements and limitations for cutting and patching Work.
- B. Hazardous Conditions Permit requirements for brazing, welding and other hot work.

1.02 RELATED SECTIONS

- A. Section 011100 – SUMMARY OF THE WORK
- B. Section 013100 – COORDINATION
- C. Section 013300 – SHOP DRAWINGS, PRODUCT DATA AND SAMPLES
- D. Section 015610 – AIRBORNE CONTAMINANTS CONTROL
- E. Section 016100 – 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/Saw Cutting Form and submit with detailed work plan fourteen (14) calendar 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.
4. Visual qualities of sight-exposed elements.
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 Project 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 <https://health.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 HCAI 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 013500 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 016100 – PRODUCT REQUIREMENTS. Use only materials for cutting, fitting, and patching which comply with the applicable

Specification Sections, and which match adjacent materials. Use materials whose installed performance will equal or surpass that of existing materials.

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.
- C. Protection. Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of the Project that might be exposed during cutting and patching operations.
- D. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas. Do not block required exit ways or stairs.
- E. Protect rated floor, wall and ceiling assemblies. Prior to cutting opening in a rated assemblies review with University's Representative and get written approval from the Fire Marshal.

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.
- F. Provide cutting and patching to accommodate all demolition work as part of this contract. Provide level and plumb cuts at locations that will be exposed or to provide smooth and even surface for patching to existing work or surfaces.
- G. Replace, patch, and repair material and surfaces cut or damaged by methods and with materials in such a manner as not to void any warranties required or existing.

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. Do not over saw cut corners and intersection unless written authorization is provided from the University Representative and the Structural Engineer of Record.
- 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 workday. Closures shall be approved by the University Fire Marshal.
- G. Refinish surface to match adjacent finish. For continuous surfaces, refinish to nearest intersection, corner or natural break and from floor to ceiling. For an assembly, refinish unit. All patched surfaces from new to existing shall provide a smooth and even transitions aligning with the adjacent surface with no visible marks, joints, seams, sheen, texture or color difference.
- 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.
- I. Visual Requirements: Do not cut and patch operating elements or related components in a manner that would, in the University's Representative's opinion, reduce the building's aesthetic qualities. Do not cut and patch construction in a manner that would result in

visual evidence of cutting and patching. Remove and replace construction cut and patched in a visually unsatisfactory manner, including by not limited to.

1. Repair and patch in areas where finishes have been visually disturbed by cutting and patching to the nearest intersections.
2. Processed concrete finishes
3. Firestopping
4. Acoustical ceilings
5. Flooring
6. Carpeting

3.05 Refer to the Following Attachment

- A. Coring/Sawcutting Notification

END OF SECTION 01 73 00

CORING/SAWCUTTING NOTIFICATION

LOCATION: _____ PROJECT#: _____
TITLE: _____

TRACKING NUMBER: _____
(Provided by PO&M)

HCAI #: _____ DATE: _____

TO: Facilities Design & Construction UC Davis Health 4800 2nd Avenue, Suite 3010 Sacramento, CA 95817 P: 916-734-7024 (Project Manager's email address)	FROM: _____

SCOPE: _____

HAS USA BEEN NOTIFIED? ☐ YES ☐ NO *When?* _____

ARE ALL KNOWN UTILITIES MARKED? ☐ YES ☐ NO *By Whom?* _____

LOCATION OF WORK SHOWN ON ATTACHED SITE PLANS? ☐ YES ☐ NO *Purpose:* _____

DATE(S) CORING OR SAWCUTTING WILL TAKE PLACE: _____ Signed: _____

UC DAVIS HEALTH USE ONLY

DATE RECEIVED: _____

WHO FROM UNIVERSITY WILL AUTHORIZE, SUPERVISE AND VERIFY?
PHONE: _____

Utilities Verified by IOR? ☐ YES ☐ NO

Activities coordinated with: ☐ PO&M ☐ Fire ☐ Telecom ☐ Occ. Safety
☐ Other (Itemize): _____

COMMENTS: _____

DATE AUTHORIZED: _____ Signed: _____
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 015610 Airborne Contaminants Control have procedures and practices that shall be implemented and followed by the Contractor for this project.
- D. Section 013900 Green Building Policy Implementation: Waste Management Program

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.
 - a. All horizontal surfaces above ceilings shall be cleaned prior to ceiling closer.
 - 3. After every concrete placement clean all wet concrete from all surfaces.
 - a. Interior and exterior
 - 4. 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.
 - 5. Broom clean with sweeping compound or HEPA Vacuum interior areas prior to start of surface finishing, and continue cleaning on an as needed basis.
 - 6. Control cleaning operations so that dust and other particles will not adhere to wet or newly coated surfaces.
 - 7. 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.
 - 8. Any dust or debris tracked out of the construction site, either by foot traffic or by debris hauling vehicles shall be cleaned by the contractor. If the dirt or other debris is determined by the University's Representative to from the contractor's activities at the jobsite it shall be cleaned in a timely manner regardless of how far from the site it is.
- B. Conduct cleaning and disposal operations in compliance with Waste Management Program per 013900 and 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. At roof areas remove all unused materials and construction waste including but not limited to screws, nails, fasteners, sheet metal cuttings, scrapes, oil, grease and adhesive. Wash down roof horizontal and vertical surfaces. Clean out all debris at roof drains.
- C. Clean walkways, driveways and streets by thorough brooming and wash-down.
- D. Clear debris from storm drainage lines and ways, leaving site ready for stormy weather.
- E. Rake landscaped areas clean.
- F. Remove waste and surplus materials, rubbish and temporary construction facilities, utilities and controls.
- G. Disinfect containment and protection areas as directed by University Representative.
- H. 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 the following but not limited to concrete splatters, paint splatters, pencil marks, pen marks, chalk line marks, tape, protective films & coatings, 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.
- I. Cleaning of Work provided by University under separate contracts, will not be required except if soiled by construction activities under this Contract.
- J. Thoroughly clean and polish all resilient flooring, metal and plastic surfaces; remove labels and protective coatings.
- K. Replace filters and clean heating and ventilating equipment used for temporary heat and ventilation.
- L. 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.
- M. 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. Power Wash, 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 Beneficial Occupancy, Substantial Completion or Final Completion; 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

SECTION 01 75 00

STARTING AND ADJUSTING SYSTEMS

PART I - GENERAL

1.01 SECTION INCLUDES

- A. Procedures for Starting Systems

1.02 RELATED SECTIONS

- A. Section 018100 – PLUMBING/HVAC TESTING PROCEDURES
- B. Section 018200 – DEMONSTRATION AND TRAINING
- C. Section 019100 - COMMISSIONING
- D. Division 22
- E. Division 23
- F. Division 25
- G. Division 26
- H. Division 27

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 ninety (90) calendar days prior to any start-up.
 - 1. Start up, testing and Commissioning of equipment shall be integrated and coordinated with the contract schedule.
 - a. Adjustments will be made as project progresses, but the sequencing will be maintained.
- B. Submit manufacturer's representative reports within one (1) week after start-up, listing satisfactory start-up dates.
- C. Provide information, manufacturer and model number of all testing equipment to be used and current certification that the testing equipment has been calibrated within the last 6 months.
- D. Maintain log with dates and results of Starting and Adjustments, and provide electronic copy to University's Representative.

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.
- D. Permanent Power is connected and operational to the building.

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. Contractor Quality Assurance Manager shall take the lead role for Starting and Adjusting the equipment; coordinate and work with the University's Representative and Inspectors throughout the entire process.
 - 1. Coordinate all start-up with the Commissioning Agent for the project.
- D. Information on hand: Have Contract Documents, shop drawings, product data, and operation and maintenance data at hand during entire start-up process.
- E. Verify each piece of equipment is anchored correctly per the manufacturer's requirements and the Contract Documents prior to energizing or starting.
- F. Verify each piece of equipment is connected to the correct power source, the breaker and conductors are the correct size. Overcurrent protection in place and required shut offs adjacent to the equipment are in place.
- G. Verify each piece of equipment has been checked for proper lubrication, drive rotation, belt tension, control sequence, and other conditions that may cause damage prior to energizing or starting.
- H. Verify control systems are fully operational in automatic mode.
- I. Manufacturer's Criteria: Verify tests, meter readings and specific electrical characteristics agree with electrical equipment manufacturers' criteria.

- J. Bearings: Inspect for cleanliness: clean and remove foreign matter, verify alignment. Take corrective action as required.
- K. 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. Verify shaft grounding protection is in place.
- L. 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. Verify shaft grounding protection is in place.

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 and the contract schedule.
- C. Follow manufacturer's requirements and recommendations for Starting and Adjusting, including any University requirements that may be listed in the Contract and Construction Documents.
- D. Equipment manufacturers representatives shall be on site for Starting and Adjusting that equipment.
- E. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- F. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- G. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

END OF SECTION 01 75 00

SECTION 01 76 00

PROTECTION of EXISTING and INSTALLED CONSTRUCTION

PART I - GENERAL

1.01 SECTION INCLUDES

- A. Protection for Products Including University Provided Products, After Installation.
- B. Protection of Existing Utilities, Interference and Underground Structures.
- C. Protection of Existing Structures and Work adjacent to new construction and demolition.

1.02 RELATED SECTIONS

- A. Section 013100 – COORDINATION
- B. Section 013900 – GREEN BUILDING POLICY IMPLEMENTATION
- C. Section 015100 – 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. As part of the Contract Work the investigation and excavation to locate existing utilities and underground structures shall be as follows, Contractor shall assume the existing known utility is within a 5 feet zone on either side of the location indicated on the Contract Documents. If the existing known utility is not located within a 5 feet zone on either side of the location indicated on the Contract Documents, the Contractor shall immediately notify the Universities Representative. The Contractor shall continue excavating until the existing utility is located. The Contractor shall be compensated for any additional excavation beyond the 5 feet zone on either side of the existing utility per 1.03D.
- C. 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.

- D. 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.
- E. 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.
- F. 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.
- G. 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 areas, 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. Protect the elevator call buttons, switches, communication devices, lights, thresholds and other components.
- F. Moisture and Humidity Protection: Protect all new installed work and existing work per the manufacturer's requirements from moisture or humidity damage including but not limited

to stored materials, finishes, gypsum board, insulation, doors, casework, millwork, equipment and all other building components.

- G. 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. At all transitions to adjacent areas not under construction.
 - 3. Lay rigid materials in place in areas subject to movement of heavy objects and where storage of products will occur.
- H. 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.
 - 3. No Construction work shall be conducted on any unprotected roof weather new or existing.
 - 4. All pathways to work on the roof shall be protected.
- I. Lawns and Landscaping: Restrict traffic of any kind across planted lawn and landscaped areas.
- J. Adjacent Facilities: Care shall be exercised to prevent damage to adjacent facilities including walks, curbs, and gutters. Adequate protection 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.

3.02 Protection of Existing Structure and Work adjacent to new construction and demolition.

- A. The Contractor shall protect existing in place work at the exterior and interior, including but not limited to finishes, materials, products, utilities, fixtures, and equipment adjacent to new construction and demolition. Any existing in place work at the exterior and interior that is damaged by the Contractor shall be repaired or replaced at no extra cost to the University.
- B. 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.

- C. 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.
- D. 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.
- E. 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.
- F. 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.
- G. Protective Coatings: Remove protective coatings, etc., as required to leave work in condition for painting and finishing, final cleaning, etc.
- H. Exterior Work: Protect all exterior work, including existing asphalt paving and landscaping and buildings.

END OF SECTION 01 76 00

SECTION 01 77 00

CLOSEOUT PROCEDURES

PART I - GENERAL

1.01 SECTION INCLUDES

- A. Project Closeout Procedures
- B. Contract Closeout Procedures
- C. Punch List of Incomplete Work or Corrections

1.02 RELATED SECTIONS

- A. Section 013100 – COORDINATION
- B. Section 013300 – SHOP DRAWINGS, PRODUCT DATA AND SAMPLES: Administrative general requirements for submittals.
- C. Section 013900 – GREEN BUILDING POLICY IMPLEMENTATION
- D. Section 015600 – TEMPORARY BARRIERS, ENCLOSURES AND CONTROLS: Removal of Controls.
- E. Section 017400 – CLEANING: Final Cleaning.
- F. Section 017800 – 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. Notify the University's Representative fourteen (14) calendar days prior to the Project being ready for permanent cores and keying.
- D. Complete start-up testing and Commissioning 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:

1. Contractor shall provide an electronic file as indicated in Item 1.04, C., (Preliminary Punch List) of items not installed, to be completed, not functioning correctly or to be corrected. The list shall include the anticipated dates of when the work is to be installed, completed or corrected.
2. Organize the List per Item 1.04, C.
3. 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).
4. Segregate architectural, plumbing, HVAC and electrical Work on separate lists.
5. 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 commissioned, tested, adjusted and balanced and are fully operational.
 - e. Indicate Operation of systems that have been demonstrated to University personnel and which systems have not been demonstrated to University personal.
 - f. Work is ready for University's Consultant's Substantial Completion review.
2. Provide minimum fourteen (14) calendar days' notice to University's Representative prior to desired date for Punch List review.

C. Organization of List (Punch List):

1. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by **Contractor** that are outside the limits of construction.
2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
3. Format Requirements: Provide the following:
 - a. Organized electronic file that is able to be filtered or queried by the following categories:
 - 1) Contractor or Subcontractor
 - 2) Building Area/Floor if applicable
 - 3) Room Number or specific interior or exterior area.
 - 4) Photo Number if applicable
 - 5) Open or Closed
 - 6) Columns for use by University's Representative
 - a) Responsible Design Consultant
 - 7) Comments
 - b. Other Punchlist Software may be used if approved by the University's Representative.
 - c. Include the following information at the top of each page:
 - 1) Project name and Number.
 - 2) Date.
 - 3) Name of University's Representative.
 - 4) Name of **Contractor**.
 - 5) Page number.

D. 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 edit the electronic file 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.
- E. Uncorrected Work: Refer to requirements specified in SECTION 014500 – QUALITY CONTROL regarding Contract adjustments for non-conforming work.
- F. Cleaning and Clearing: Prior to Substantial Completion review, execute cleaning and clearing site of temporary facilities and controls, as specified in SECTION 015600 – TEMPORARY BARRIERS, ENCLOSURES AND CONTROLS and SECTION 017400 CLEANING
- G. Testing and Inspection: Prior to Substantial Completion review, complete all tests and inspections and submit applicable reports and approvals. Provide commissioning of building systems per Section 013900 GREEN BUILDING POLICY IMPLEMENTATION.
 1. Complete materials tests and inspections.
 2. Complete commissioning, testing, inspection, balancing, sterilization and cleaning of plumbing and HVAC systems.
 3. Complete commissioning, testing and inspection of electrical system.
 4. Complete commissioning and operational tests of equipment.
 5. IF HCAI PROJECT: Submit electronic file of **Contractor's** Final HCAI 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 SUBMITTALS (See 017800 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 (Mark as NOT USED if not project applicable.)
 4. Changes under unit prices (Mark as NOT USED if not project applicable.)
 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 012900 – MEASUREMENT AND PAYMENT and the General Conditions of the Contract.
- B. Submit As-Built Documents to University's Representative with final Application for Payment.

PART II - PRODUCTS – Not Applicable to this Section

PART III - PART III - EXECUTION

3.01 REPAIR OF THE WORK

- A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.

- B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.
1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
 2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that already show evidence of repair or restoration.
 - a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
 3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
 4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use.

3.02 REPAIR PERIOD (GUARANTEE OR WARRANTY PERIOD)

- A. Upon acceptance of the project or a portion thereof from the **Contractor**, the "Guarantee to Repair Period" of one year or more will begin as described in Article 9 of the General Conditions. The University Representative will become responsible for receiving notices of Defective Work from building occupants and securing **Contractor** compliance where applicable. The University Representative shall have prime responsibility for follow-up & monitoring of **Contractor** activities. (Refer to Article 12 of General Conditions).
1. If the **Contractor** must "Shut-down" the fire and security alarms in an occupied building, then the **Contractor** shall be responsible to provide a fire and security watch until the system, at no additional cost to the University.

END OF SECTION 01 77 00

SECTION 01 78 00

CLOSEOUT SUBMITTALS

PART I - GENERAL

1.01 SECTION INCLUDES

- A. Equipment Data
- B. Operation and Maintenance Instructions
- C. Instruction of University personnel
- D. Schedule of Submittals
- E. Spare Parts and Maintenance Materials
- F. Guarantees, Warranties, Bonds, Service and Maintenance Contracts
- G. Project Record Documents

1.02 RELATED SECTIONS

- A. Section 013100 – COORDINATION
- B. Section 013300 – SHOP DRAWINGS, PRODUCT DATA AND SAMPLES
- C. Administrative general requirements for submittals.
- D. Section 013900 – GREEN BUILDING POLICY IMPLEMENTATION
- E. Section 014500 – QUALITY CONTROL: Manufacturer's tests and inspections as a condition of warranty.
- F. Section 016100 – PRODUCT REQUIREMENTS
- G. Section 017700 – CLOSEOUT PROCEDURES

1.03 FILE FORMATS

- A. All printed documents submitted per this section shall be in PDF format
 - 1. The PDF files will be unlocked and searchable.
 - 2. All PDF documents will be bookmarked.
 - 3. The exception to electronic format for As-Built drawings will be noted in the specific specification section where they are required.
- B. Digital Photography
 - 1. All files will be submitted in JPEG

1.04 EQUIPMENT DATA AND OPERATION AND MAINTENANCE (O&M) 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
- B. O&M Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at time of Section Submittals. Submit reviewed manual content formatted and organized as required by this Section. Prepare in the form of a data and instructional manual.
- C. Submit PDF electronic files of operation and maintenance manuals. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to the University. The exception to electronic format will be indicated in the specific specification section requiring hard copies of the manual.
 - 1. Name each indexed document file in composite electronic index with applicable item name. Include a completed electronically linked operation and maintenance directory.
 - a. List Project title and Project number and particular building as applicable.
 - b. Enable inserted reviewer comments on draft submittals.
 - 2. Organization: Arrange content by systems under Section numbers and sequence in accordance with the Project Specifications Table of Contents.
- D. Table of Contents, Each Volume: Provide title of Project, Project number, 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 As-Builts 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 014500 – QUALITY CONTROL.
 - 5. Warranties and Bonds: Include in each applicable section.

E. Manual for Materials and Finishes:

1. Building Products, applied Materials, and Finishes: Provide PDF composite electronically indexed file. 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.
3. Moisture Protection and Weather Exposed Products: Include product data listing applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance, and repair.
4. Additional Requirements: As specified in individual Specification Sections.
5. Table of Contents: Provide PDF electronic file with links to individual sections.

F. 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 PDF composite electronically indexed file 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. Submit drafts for review before preparing final PDF electronic file.
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 shall be updated to 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.
 14. Additional Requirements: As specified in individual Specification Sections.
- G. 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.
- H. Equipment Data and Operation and Maintenance Instructions Submittals:
1. Submittals: Comply with administrative requirements specified in SECTION 013300 – SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
 2. Preliminary Draft O&M Submittal: Submit electronic files of each manual at least 180 calendar days before commencing demonstration and training. University's Representative will review draft and return with comments.
 - a. The comments or corrections shall be incorporated into the Final O&M submittal.
 - b. Correct or revise each manual to comply with the University's Representatives comments. Submit electronic copies of each corrected manual within 14 calendar days of receipt of University's Representative's comments.
 - c. University's Representative will notify the Contractor when the edits have been accepted for incorporation into the final O&M submittal.
 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 O&M 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 each manual in the final form prior to requesting inspection for Substantial Completion. The University's Representative will return comments electronically.

- a. Submit electronic copies of each manual prior to requesting training.

1.05 SPARE PARTS, EXTRA STOCK 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.
 3. Provide itemized list of all spare parts, materials and transmittal to the University's Representative for acceptance.
- B. Storage, maintenance: Store products with products to be installed in the Work, as specified in SECTION 016100 – 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.

1.06 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

- A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information. Include a section in the directory for each of the following:
 1. List of Documents: Include a table of contents for each O&M and emergency, operations listed per CSI Specification number.
 2. List of Systems and Subsystems: Include references to operation and maintenance manuals that contain information about each system.
 3. List of Equipment: List equipment for each system, organized by system. For pieces of equipment not part of system, list separately.

4. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."
5. This Directory shall be submitted to the University's Representative for review and acceptance.

1.07 MAINTENANCE AGREEMENTS

- A. Prior to Closeout all Maintenance Agreements required by the Contract Documents shall be assembled and submitted electronically with the Closeout Submittal Requirements.
 1. Provide all Maintenance Agreements in PDF form.
 - a. Submit individual files for each Maintenance Agreement with a directory assembled by CSI division.
 - 1) Combine all project Maintenance Agreements including the directory into one PDF for record.
 - 2) Files will be formatted for printing with a footer identifying the CSI number and UC Davis Health project number.
 - 3) There will be a front cover to the file that contains all project information including the Contractor contact information.

1.08 EMERGENCY MANUALS

- A. Content: Organize manual into a separate section for each of the following:
 1. Type of emergency.
 2. Emergency instructions.
 3. Emergency procedures.
- B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
 1. Fire.
 2. Flood.
 3. Gas leak.
 4. Water leak.
 5. Power failure.
 6. Water outage.
 7. System, subsystem, or equipment failure.
 8. Chemical release or spill.

- C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of University's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- D. Emergency Procedures: Include the following, as applicable:
 - 1. Instructions on stopping.
 - 2. Shutdown instructions for each type of emergency.
 - 3. Operating instructions for conditions outside normal operating limits.
 - 4. Required sequences for electric or electronic systems.
 - 5. Special operating instructions and procedures.

1.09 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 49 of the Contract Specifications, including content and limitations.
 - 5. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve **Contractor** of warranty on work that incorporates the products, nor does it relieve suppliers, manufacturers, and subcontractor's 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. University Recourse: Written warranties made to the 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 PDF electronically signed or signed and scanned copies of each. Organize documents into an orderly sequence based on the table of contents of the Project Manual CSI divisions.
 2. Table of Contents: Provide PDF electric file with links to individual warranty sections. Include the following information.
 - 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. Warranty Submittal

1. Provide all warranties in PDF composite electronically indexed files.

a. Submit individual files for each warranty with a directory assembled by CSI division.

- 1) Combine all project warranties including the directory into one PDF for record
- 2) Files will be formatted for printing with a footer identifying the CSI Number and UC Davis Health Project Number.
- 3) There will be a front cover to the file that contains the title "WARRANTY, GUARANTEE AND BOND" as well as all project information including the **Contractor** contact information. Title of Project and UC Davis Health Project Name and Number.
- 4) Coordinate copies of each warranty to be included in operation and maintenance manuals.
- 5) Final Submittal shall be incorporated into one PDF, bookmarked and searchable document.

F. Time of Submittals: Submit **[60]** calendar days 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.

1.10 PROJECT AS-BUILT RECORD DOCUMENTS

A. Maintenance of As-Built Documents and Samples:

1. Provide complete set of As-Built Drawings and Specifications, showing every change from original Contract set, including all Addenda, Change Order, job decisions, etc. PDFs for this purpose may be obtained from University's Representative.
2. Refer to Section 017700 CLOSEOUT PROCEDURES for additional requirements for As-Built Documents.
3. When work is complete and prior to final payment, submit one (1) complete set of all As-Built documents, marked to show any deviation from the original Contract set. These documents are to be an accurate description of all work as constructed.
4. As-Built Schedule: **Contractor** shall provide As-Built Schedule of construction activities. Schedule shall be in same format as specified in SECTION 013200 – CONTRACT SCHEDULES.

- B. As-Built Drawings: Comply with the following:
1. Number of Copies: Submit one PDF file bookmarked and searchable of marked-up As-Built.
 - a. Initial Submittal:
 - 1) Submit PDF As-Built digital data files.
 - 2) Submit digital data files per UC Davis Health Campus Design Guidelines.
 - 3) University's Representative will indicate whether general scope of changes, additional information recorded, and quality of document are acceptable.
 - b. Final Submittal:
 - 1) Submit PDF electronic files of digital As-Built.
 - 2) Submit digital data files per UC Davis Health Campus Design Guidelines.
 - 3) Final submittals of all formats will include all documents whether changes were made or not.
- C. As-Built Specifications: Submit one annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.
- D. As-Built Product Data: Submit annotated PDF electronic files and directories of each submittal.
1. When As-Built Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.
- E. Miscellaneous As-Built Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories of each submittal.
- F. Submittals: At Contract closeout, deliver Record Documents and samples as required by SECTION 017700 – CLOSEOUT PROCEDURES.
1. Transmit with cover letter listing:
 - a. Date.
 - b. Project title and Project number.
 - c. **Contractor's** name, address and telephone number.
 - d. Number and title of each Record Document.
 - e. Signature of **Contractor** or authorized representative.

1.11 AS-BUILT SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
 3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
 4. Note related Change Orders, As-Built Product Data, and As-Built Drawings where applicable.
 5. Format: Submit As-Built Specifications as annotated PDF electronic file.

1.12 AS-BUILT PRODUCT DATA

- A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 3. Note related Change Orders, As-Built Specifications, and As-Built Drawings where applicable.
 4. Format: Submit As-Built Product Data as annotated PDF electronic file Include As-Built Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

1.13 AS-BUILT SAMPLES

- A. Preparation: Mark Samples to identify the material and location or use on project; indicate finish designations of materials and products, where designations are indicated on Drawings. Cross-reference Samples with corresponding Product Data submitted.
1. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 2. Note related Change Orders, As-Built Specifications, and As-Built Drawings where applicable.
 3. Format: Submit As-Built Samples in same size and format as indicated for each sample in the specification's sections. Pack samples securely, with protective wrapping. Include As-Built Samples directory organized by Specification Section number and title.
 4. Each Sample will be labeled with Manufacturer, Model, Product Number, CSI Section and UC Davis Health Project Name and Number.

1.14 MISCELLANEOUS AS-BUILT SUBMITTALS

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work.
 - 1. Format: Submit miscellaneous As-Built submittals as PDF electronic file. Include miscellaneous As-Built submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous As-Built submittals.

1.15 PHOTOGRAPHS

- A. General: Prior to Closeout all photographic documentation required per 013220 Construction Progress Reporting shall be assembled and submitted with the Closeout Submittal Requirements.

1.16 CONSENT OF SURETY AND FINAL CERTIFICATES

- A. General: Prior to closeout Consent of Surety and Final Certificates required by the Contract Documents shall be assembled and submitted with the Closeout Submittal Requirements.

PART II - PRODUCTS – Not Applicable to this Section

PART III - EXECUTION

3.01 Refer to the following attachments

- A. Guarantee
- B. Report of Work Required by Warranty

END OF SECTION 017800

GUARANTEE

Project Title: _____

Project Location: _____

Project Number: _____ DATE: _____

GUARANTEE FOR _____ (the "Contract"),

(Specification SECTION and 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: _____

PROJECT NO. #####
PROJECT TITLE
PROJECT SUBTITLE

REPORT OF WORK REQUIRED BY WARRANTY

To:	(PM's NAME), University Representative
From:	

[illegible]

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**.

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 017800 – CLOSEOUT SUBMITTALS
- B. Section 018100 – 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 thirty (30) calendar days prior to activities.
- B. Submit reports and videos within (14) calendar days after completion of demonstrations and instructions. Give time and date of each training session, and hours devoted to training with a list of persons present and the corresponding video.

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, commissioned, and put into operation.
- B. Send approved pdf version of completed operation and maintenance manual 7 calendar days prior to training.

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. Display on a video screen and demonstrate the use of bookmarks and searches to find information being sought.
- 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

SECTION 01 91 13
GENERAL COMMISSIONING REQUIREMENTS

PART 1 GENERAL

1.01 SUMMARY

- A. Commissioning is intended to achieve the following specific objectives; this section specifies the Contractor's responsibilities for commissioning:
 - 1. Verify that the work is installed in accordance with the Contract Documents and the manufacturer's recommendations and instructions, and that it receives adequate operational checkout prior to startup: Startup reports and Prefunctional Checklists executed by Contractor are utilized to achieve this.
 - 2. Verify and document that functional performance is in accordance with the Contract Documents: Functional Tests executed by Contractor and witnessed by the Commissioning Authority are utilized to achieve this.
 - 3. Verify that operation and maintenance manuals submitted to Owner are complete: Detailed operation and maintenance (O&M) data submittals by Contractor are utilized to achieve this.
 - 4. Verify that the Owner's operating personnel are adequately trained: Formal training conducted by Contractor is utilized to achieve this.
- B. The Commissioning Authority directs and coordinates all commissioning activities; this section describes some but not all of the Commissioning Authority's responsibilities.
- C. The Commissioning Authority is employed by Owner.

1.02 SCOPE OF COMMISSIONING

- A. The following are to be commissioned:
- B. Plumbing Systems:
- C. HVAC System, including:
- D. Electrical Systems:
- E. Electronic Safety and Security:
- F. Communications:
- G. Other equipment and systems explicitly identified elsewhere in Contract Documents as requiring commissioning.

1.03 RELATED REQUIREMENTS

- A. Section 01 77 00 - Closeout Procedures: General startup requirements.

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- B. Section 01 78 00 - Closeout Submittals: Scope and procedures for operation and maintenance manuals and project record documents.
- C. Section 01 79 00 - Demonstration and Training01 82 00 - Demonstration and Training: Scope and procedures for Owner personnel training.
- D. Section 01 91 14 - Commissioning Authority Responsibilities.

1.04 SUBMITTALS

- A. See Section 01 33 00 - Shop Drawings, Product Data, and Samples, for submittal procedures; except:
 - 1. Make all submittals specified in this section, and elsewhere where indicated for commissioning purposes, directly to the Commissioning Authority, unless they require review by Architect; in that case, submit to Architect first.
 - 2. Submit one copy to the Commissioning Authority, not to be returned.
 - 3. Make commissioning submittals on time schedule specified by Commissioning Authority.
 - 4. Submittals indicated as "Draft" are intended for the use of the Commissioning Authority in preparation of Prefunctional Checklists or Functional Test requirements; submit in editable electronic format, Microsoft Word 2010 preferred.
 - 5. As soon as possible after submittals made to Architect are approved, submit copy of approved submittal to the Commissioning Authority.
- B. Product Data: If submittals to Architect do not include the following, submit copies as soon as possible:
 - 1. Manufacturer's product data, cut sheets, and shop drawings.
 - 2. Manufacturer's installation instructions.
 - 3. Startup, operating, and troubleshooting procedures.
 - 4. Fan and pump curves.
 - 5. Factory test reports.
 - 6. Warranty information, including details of Owner's responsibilities in regard to keeping warranties in force.
- C. Manufacturers' Instructions: Submit copies of all manufacturer-provided instructions that are shipped with the equipment as soon as the equipment is delivered.
- D. Startup Plans and Reports.
- E. Completed Prefunctional Checklists.

PART 2 PRODUCTS

2.01 TEST EQUIPMENT

- A. Provide all standard testing equipment required to perform startup and initial checkout and required Functional Testing; unless otherwise noted such testing equipment will NOT become the property of Owner.
- B. Calibration Tolerances: Provide testing equipment of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified. If not otherwise noted, the following minimum requirements apply:
 - 1. Temperature Sensors and Digital Thermometers: Certified calibration within past year to accuracy of 0.5 degree F and resolution of plus/minus 0.1 degree F.
 - 2. Pressure Sensors: Accuracy of plus/minus 2.0 percent of the value range being measured (not full range of meter), calibrated within the last year.
 - 3. Calibration: According to the manufacturer's recommended intervals and when dropped or damaged; affix calibration tags or keep certificates readily available for inspection.
- C. Equipment-Specific Tools: Where special testing equipment, tools and instruments are specific to a piece of equipment, are only available from the vendor, and are required in order to accomplish startup or Functional Testing, provide such equipment, tools, and instruments as part of the work at no extra cost to Owner; such equipment, tools, and instruments are to become the property of Owner.
- D. Dataloggers: Independent equipment and software for monitoring flows, currents, status, pressures, etc. of equipment.
 - 1. Dataloggers required to for Functional Tests will be provided by the Commissioning Authority and will not become the property of Owner.

PART 3 EXECUTION

3.01 COMMISSIONING PLAN

- A. Commissioning Authority has prepared the Commissioning Plan.
 - 1. Attend meetings called by the Commissioning Authority for purposes of completing the commissioning plan.
 - 2. Require attendance and participation of relevant subcontractors, installers, suppliers, and manufacturer representatives.
- B. Contractor is responsible for compliance with the Commissioning Plan.
- C. Commissioning Plan: The commissioning schedule, procedures, and coordination requirements for all parties in the commissioning process.

D. Commissioning Schedule:

1. Submit anticipated dates of startup of each item of equipment and system to Commissioning Authority within 60 days after award of Contract.
2. Re-submit anticipated startup dates monthly, but not less than 4 weeks prior to startup.
3. Prefunctional Checklists and Functional Tests are to be performed in sequence from components, to subsystems, to systems.
4. Provide sufficient notice to Commissioning Authority for delivery of relevant Checklists and Functional Test procedures, to avoid delay.

3.02 STARTUP PLANS AND REPORTS

- A. Startup Plans: For each item of equipment and system for which the manufacturer provides a startup plan, submit the plan not less than 8 weeks prior to startup.
- B. Startup Reports: For each item of equipment and system for which the manufacturer provides a startup checklist (or startup plan or field checkout sheet), document compliance by submitting the completed startup checklist prior to startup, signed and dated by responsible entity.
- C. Submit directly to the Commissioning Authority.

3.03 PREFUNCTIONAL CHECKLISTS

- A. A Prefunctional Checklist is required to be filled out for each item of equipment or other assembly specified to be commissioned.
 1. No sampling of identical or near-identical items is allowed.
 2. These checklists do not replace manufacturers' recommended startup checklists, regardless of apparent redundancy.
 3. Prefunctional Checklist forms will not be complete until after award of the contract; the following types of information will be gathered via the completed Checklist forms:
 - a. Certification by installing contractor that the unit is properly installed, started up, and operating and ready for Functional Testing.
 - b. Confirmation of receipt of each shop drawing and commissioning submittal specified, itemized by unit.
 - c. Manufacturer, model number, and relevant capacity information; list information "as specified," "as submitted," and "as installed."
 - d. Serial number of installed unit.

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- e. List of inspections to be conducted to document proper installation prior to startup and Functional Testing; these will be primarily static inspections and procedures; for equipment and systems may include normal manufacturer's start-up checklist items and minor testing.
 - f. Sensor and actuator calibration information.
- B. Contractor is responsible for filling out Prefunctional Checklists, after completion of installation and before startup; witnessing by the Commissioning Authority is not required unless otherwise specified.
- 1. Each line item without deficiency is to be witnessed, initialed, and dated by the actual witness; checklists are not complete until all line items are initialed and dated complete without deficiencies.
 - 2. Checklists with incomplete items may be submitted for approval provided the Contractor attests that incomplete items do not preclude the performance of safe and reliable Functional Testing; re-submission of the Checklist is required upon completion of remaining items.
 - 3. Individual Checklists may contain line items that are the responsibility of more than one installer; Contractor shall assign responsibility to appropriate installers or subcontractors, with identification recorded on the form.
 - 4. If any Checklist line item is not relevant, record reasons on the form.
 - 5. Contractor may independently perform startup inspections and/or tests, at Contractor's option.
 - 6. Regardless of these reporting requirements, Contractor is responsible for correct startup and operation.
 - 7. Submit completed Checklists to Commissioning Authority within two days of completion.
- C. Commissioning Authority is responsible for furnishing the Prefunctional Checklists to Contractor.
- 1. Initial Drafts: Contractor is responsible for initial draft of Prefunctional Checklist where so indicated in the Contract Documents.
 - 2. Provide all additional information requested by Commissioning Authority to aid in preparation of checklists, such as shop drawing submittals, manufacturers' startup checklists, and O&M data.
 - 3. Commissioning Authority may add any relevant items deemed necessary regardless of whether they are explicitly mentioned in the Contract Documents or not.
 - 4. When asked to review the proposed Checklists, do so in a timely manner.

- D. Commissioning Authority Witnessing: Required for:
 - 1. Each piece of primary equipment, unless sampling of multiple similar units is allowed by the commissioning plan.
 - 2. A sampling of non-primary equipment, as allowed by the commissioning plan.
- E. Deficiencies: Correct deficiencies and re-inspect or re-test, as applicable, at no extra cost to Owner.
 - 1. If difficulty in correction would delay progress, report deficiency to the Commissioning Authority immediately.

3.04 FUNCTIONAL TESTS

- A. A Functional Test is required for each item of equipment, system, or other assembly specified to be commissioned, unless sampling of multiple identical or near-identical units is allowed by the final test procedures.
- B. Contractor is responsible for execution of required Functional Tests, after completion of Prefunctional Checklist and before closeout.
- C. Commissioning Authority is responsible for witnessing and reporting results of Functional Tests, including preparation and completion of forms for that purpose.
- D. Contractor is responsible for correction of deficiencies and re-testing at no extra cost to Owner; if a deficiency is not corrected and re-tested immediately, the Commissioning Authority will document the deficiency and the Contractor's stated intentions regarding correction.
 - 1. Deficiencies are any condition in the installation or function of a component, piece of equipment or system that is not in compliance with the Contract Documents or does not perform properly.
 - 2. When the deficiency has been corrected, the Contractor completes the form certifying that the item is ready to be re-tested and returns the form to the Commissioning Authority; the Commissioning Authority will reschedule the test and the Contractor shall re-test.
 - 3. Identical or Near-Identical Items: If 10 percent, or three, whichever is greater, of identical or near-identical items fail to perform due to material or manufacturing defect, all items will be considered defective; provide a proposal for correction within 2 weeks after notification of defect, including provision for testing sample installations prior to replacement of all items.
 - 4. Contractor shall bear the cost of Owner and Commissioning Authority personnel time witnessing re-testing.
 - 5. Contractor shall bear the cost of Owner and Commissioning Authority personnel time witnessing re-testing if the test failed due to failure to execute the relevant Prefunctional Checklist correctly; if the test failed for reasons that would not have

been identified in the Prefunctional Checklist process, Contractor shall bear the cost of the second and subsequent re-tests.

E. Functional Test Procedures:

1. Some test procedures are included in the Contract Documents; where Functional Test procedures are not included in the Contract Documents, test procedures will be determined by the Commissioning Authority with input by and coordination with Contractor.
2. Examples of Functional Testing:
 - a. Test the dynamic function and operation of equipment and systems (rather than just components) using manual (direct observation) or monitoring methods under full operation (e.g., the chiller pump is tested interactively with the chiller functions to see if the pump ramps up and down to maintain the differential pressure setpoint).
 - b. Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarm, power failure, etc.
 - c. Systems are run through all the HVAC control system's sequences of operation and components are verified to be responding as the sequence's state.
 - d. Traditional air or water test and balancing (TAB) is not Functional Testing; spot checking of TAB by demonstration to the Commissioning Authority is Functional Testing.

- F. Deferred Functional Tests: Some tests may need to be performed later, after substantial completion, due to partial occupancy, equipment, seasonal requirements, design or other site conditions; performance of these tests remains the Contractor's responsibility regardless of timing.

3.05 SENSOR AND ACTUATOR CALIBRATION

- A. Calibrate all field-installed temperature, relative humidity, carbon monoxide, carbon dioxide, and pressure sensors and gauges, and all actuators (dampers and valves) on this piece of equipment shall be calibrated. Sensors installed in the unit at the factory with calibration certification provided need not be field calibrated.
- B. Calibrate using the methods described below; alternate methods may be used, if approved by Commissioning Authority and Owner beforehand. See PART 2 for test instrument requirements. Record methods used on the relevant Prefunctional Checklist or other suitable forms, documenting initial, intermediate and final results.
- C. All Sensors:

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1. Verify that sensor location is appropriate and away from potential causes of erratic operation.
2. Verify that sensors with shielded cable are grounded only at one end.
3. For sensor pairs that are used to determine a temperature or pressure difference, for temperature make sure they are reading within 0.2 degree F of each other, and for pressure, within tolerance equal to 2 percent of the reading, of each other.
4. Tolerances for critical applications may be tighter.

D. Sensors Without Transmitters - Standard Application:

1. Make a reading with a calibrated test instrument within 6 inches of the site sensor.
2. Verify that the sensor reading, via the permanent thermostat, gauge or building automation system, is within the tolerances in the table below of the instrument-measured value.
3. If not, install offset, calibrate or replace sensor.

E. Sensors With Transmitters - Standard Application.

1. Disconnect sensor.
2. Connect a signal generator in place of sensor.
3. Connect ammeter in series between transmitter and building automation system control panel.
4. Using manufacturer's resistance-temperature data, simulate minimum desired temperature.
5. Adjust transmitter potentiometer zero until 4 mA is read by the ammeter.
6. Repeat for the maximum temperature matching 20 mA to the potentiometer span or maximum and verify at the building automation system.
7. Record all values and recalibrate controller as necessary to comply with specified control ramps, reset schedules, proportional relationship, reset relationship and P/I reaction.
8. Reconnect sensor.
9. Make a reading with a calibrated test instrument within 6 inches of the site sensor.
10. Verify that the sensor reading, via the permanent thermostat, gauge or building automation system, is within the tolerances in the table below of the instrument-measured value.
11. If not, replace sensor and repeat.

12. For pressure sensors, perform a similar process with a suitable signal generator.
- F. Sensor Tolerances for Standard Applications: Plus/minus the following maximums:
1. Watthour, Voltage, Amperage: 1 percent of design.
 2. Pressure, Air, Water, Gas: 3 percent of design.
 3. Air Temperatures (Outside Air, Space Air, Duct Air): 0.4 degrees F.
 4. Relative Humidity: 4 percent of design.
 5. Barometric Pressure: 0.1 inch of Hg.
 6. Flow Rate, Air: 10 percent of design.
 7. Flow Rate, Water: 4 percent of design.
 8. AHU Wet Bulb and Dew Point: 2.0 degrees F.
- G. Critical Applications: For some applications more rigorous calibration techniques may be required for selected sensors. Describe any such methods used on an attached sheet.
- H. Valve/Damper Stroke Setup and Check:
1. For all valve/damper actuator positions checked, verify the actual position against the control system readout.
 2. Set pump/fan to normal operating mode.
 3. Command valve/damper closed; visually verify that valve/damper is closed and adjust output zero signal as required.
 4. Command valve/damper to open; verify position is full open and adjust output signal as required.
 5. Command valve/damper to a few intermediate positions.
 6. If actual valve/damper position does not reasonably correspond, replace actuator or add pilot positioner (for pneumatics).
- I. Isolation Valve or System Valve Leak Check: For valves not associated with coils.
1. With full pressure in the system, command valve closed.
 2. Use an ultra-sonic flow meter to detect flow or leakage.

3.06 TEST PROCEDURES - GENERAL

- A. Provide skilled technicians to execute starting of equipment and to execute the Functional Tests. Ensure that they are available and present during the agreed upon

schedules and for sufficient duration to complete the necessary tests, adjustments and problem-solving.

- B. Provide all necessary materials and system modifications required to produce the flows, pressures, temperatures, and conditions necessary to execute the test according to the specified conditions. At completion of the test, return all affected equipment and systems to their pre-test condition.
- C. Sampling: Where Functional Testing of fewer than the total number of multiple identical or near-identical items is explicitly permitted, perform sampling as follows:
 - 1. Identical Units: Defined as units with same application and sequence of operation; only minor size or capacity difference.
 - 2. Sampling is not allowed for:
 - a. Major equipment.
 - b. Life-safety-critical equipment.
 - c. Prefunctional Checklist execution.
 - 3. XX = the percent of the group of identical equipment to be included in each sample; defined for specific type of equipment.
 - 4. YY = the percent of the sample that if failed will require another sample to be tested; defined for specific type of equipment.
 - 5. Randomly test at least XX percent of each group of identical equipment, but not less than three units. This constitutes the "first sample."
 - 6. If YY percent of the units in the first sample fail, test another XX percent of the remaining identical units.
 - 7. If YY percent of the units in the second sample fail, test all remaining identical units.
 - 8. If frequent failures occur, resulting in more troubleshooting than testing, the Commissioning Authority may stop the testing and require Contractor to perform and document a checkout of the remaining units prior to continuing testing.
- D. Manual Testing: Use 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").
- E. Simulating Conditions: Artificially create the necessary condition for the purpose of testing the response of a system; for example apply hot air to a space sensor using a hair dryer to see the response in a VAV box.
- F. Simulating Signals: Disconnect the sensor and use a signal generator to send an amperage, resistance or pressure to the transducer and control system to simulate the

sensor value.

- G. Over-Writing Values: Change the sensor value known to the control system in the control system to see the response of the system; for example, change the outside air temperature value from 50 degrees F to 75 degrees F to verify economizer operation.
- H. Indirect Indicators: Remote indicators of a response or condition, such as a reading from a control system screen reporting a damper to be 100 percent closed, are considered indirect indicators.
- I. Monitoring: Record parameters (flow, current, status, pressure, etc.) of equipment operation using dataloggers or the trending capabilities of the relevant control systems; where monitoring of specific points is called for in Functional Test Procedures:
 - 1. All points that are monitored by the relevant control system shall be trended by Contractor; at the Commissioning Authority's request, Contractor shall trend up to 20 percent more points than specified at no extra charge.
 - 2. Other points will be monitored by the Commissioning Authority using dataloggers.
 - 3. At the option of the Commissioning Authority, some control system monitoring may be replaced with datalogger monitoring.
 - 4. Provide hard copies of monitored data in columnar format with time down left column and at least 5 columns of point values on same page.
 - 5. Graphical output is desirable and is required for all output if the system can produce it.
 - 6. Monitoring may be used to augment manual testing.

3.07 OPERATION AND MAINTENANCE MANUALS

- A. See Section 01 78 00 - Closeout Submittals for additional requirements.
- B. Add design intent documentation furnished by Architect to manuals prior to submission to Owner.
- C. Submit manuals related to items that were commissioned to Commissioning Authority for review; make changes recommended by Commissioning Authority.
- D. Commissioning Authority will add commissioning records to manuals after submission to Owner.

END OF SECTION

SECTION 01 91 14
COMMISSIONING AUTHORITY RESPONSIBILITIES

PART 1 GENERAL

1.01 SUMMARY

- A. Commissioning is intended to achieve the following specific objectives; this section covers the Commissioning Authority's responsibilities for commissioning:
 - 1. Verify that the work is installed in accordance with the Contract Documents and the manufacturer's recommendations and instructions, and that it receives adequate operational checkout prior to startup: Startup reports and Prefunctional Checklists are utilized to achieve this.
 - 2. Verify and document that functional performance is in accordance with the Contract Documents: Functional Tests performed by Contractor and witnessed by the Commissioning Authority are utilized to achieve this.
 - 3. Verify that operation and maintenance manuals submitted to Owner are complete: Detailed O&M data submittals are specified.
 - 4. Verify that the Owner's operating personnel are adequately trained: Formal training conducted by Contractor is specified.
- B. Commissioning, including Functional Tests, O&M documentation review, and training, is to occur after startup and initial checkout and be completed before Substantial Completion.
- C. Coordinate and direct all the commissioning activities in a logical, sequential and efficient manner using consistent protocols and forms, centralized documentation, clear and regular communications and consultations with all necessary parties, frequently updated timelines and schedules and technical expertise.
- D. The Commissioning Authority is to be employed by Owner.

1.02 SCOPE OF COMMISSIONING

- A. The following are to be commissioned:
 - B. Plumbing Systems:
 - C. HVAC System:
 - D. Special Ventilation:
 - E. Electrical Systems:
 - F. Electronic Safety and Security:
 - G. Communications:

- H. Other equipment and systems explicitly identified elsewhere in Contract Documents as requiring commissioning.

1.03 REFERENCE STANDARDS

- A. ASHRAE Guideline 1.1 - HVAC&R Technical Requirements for the Commissioning Process 2007, with Errata (2012).
- B. CSI/CSC MF - Masterformat 2016.
- C. PEGI (MCP) - Model Commissioning Plan Current Edition.

1.04 SUBMITTALS

- A. Commissioning Plan:
 - 1. Submit preliminary draft for review by Owner and Architect within 30 days after commencement of Commissioning Authority contract.
 - 2. Submit revised draft to be included in the construction contract documents, not less than 4 weeks prior to bid date.
 - 3. Submit final plan not more than 90 days after commencement of construction, for issuance to all parties.
- B. List of Prefunctional Checklists to be developed:
 - 1. Submit preliminary list at start of construction documents phase or within 30 days after commencement of contract, whichever is later.
 - 2. Submit revised list not less than 6 weeks prior to bid date, for inclusion in the construction contract documents.
 - 3. Submit final list not more than 60 days after start of construction.
- C. Prefunctional Checklists:
 - 1. Submit preliminary draft at start of construction documents phase or within 30 days after commencement of contract, whichever is later.
 - 2. Submit revised draft for review by Owner and Architect not less than 6 weeks prior to bid date, for inclusion in the construction contract documents.
 - 3. Submit final draft to Contractor not less than 4 weeks prior to startup of particular items to be commissioned.
- D. List of Functional Test procedures to be developed:
 - 1. Submit preliminary list at start of construction documents phase or within 30 days after commencement of contract, whichever is later.

2. Submit revised list not less than 6 weeks prior to bid date, for inclusion in the Contract Documents; this is intended to be a list of titles, not full description of the tests.
 3. Submit final list not more than 60 days after start of construction.
- E. Functional Test Procedures:
1. Submit preliminary draft at start of construction documents phase or within 30 days after commencement of contract, whichever is later.
 2. Submit revised draft for review by Owner and Architect not less than 6 weeks prior to bid date, for inclusion in the construction contract documents.
 3. Submit final draft to Contractor not less than 4 weeks prior to startup of particular items to be commissioned.
- F. Training Plan.
- G. Recommissioning Manual: Submit within 60 days after receipt of Owner's instructions to proceed with preparation.
- H. Commissioning Record: Submit to Contractor for inclusion with O&M manuals.
- I. Final Commissioning Report: Submit to Owner.

PART 2 PRODUCTS

2.01 DOCUMENTATION IDENTIFICATION SYSTEM

- A. Give each submitted form or report a unique identification; use the following scheme.
- B. Type of Document: Use the following prefixes:
1. Commissioning Plan: CP-.
 2. Prefunctional Checklist: PC-.
 3. Functional Test Procedure: FTP-.
 4. Functional Test Report: FTR-.
 5. Commissioning Report: CR-.
- C. System Type: Use the first 4 digits from CSI/CSC MF (Master Format), that are applicable to the system; for example:
1. 2300: HVAC system as a whole.
 2. 2320: HVAC Piping and Pumps.
 3. 2330: HVAC Air Distribution.

- D. Component Number: Assign numbers sequentially, using 1, 2, or 3 digits as required to accommodate the number of units in the system.
- E. Test, Revision, or Submittal Number: Number each successive iteration sequentially, starting with 1.
- F. Example: PC-2320-001.2 would be the Prefunctional Checklist for equipment item 1 in the HVAC piping system, probably a pump; this is the second, revised submittal of this checklist.

PART 3 EXECUTION

3.01 COMMISSIONING PLAN

- A. Prepare and maintain the Commissioning Plan, covering commissioning schedule, Prefunctional Checklist and Functional Test procedures, coordination requirements, and forms to be used, for all parties in the commissioning process.
 - 1. Call and chair meetings of the Commissioning Team when appropriate.
 - 2. Give Contractor sufficient notice for scheduling commissioning activities.
 - 3. Develop a comprehensive start-up and initial systems checkout plan with cooperation of Contractor and subcontractors.
 - 4. PECl (MCP) may be used as a guide for the Commissioning Plan.
 - 5. ASHRAE Guideline 1.1 may be used as a guide for the Commissioning Plan.
 - 6. Avoid replication of information included in the construction contract documents to the greatest extent possible.
- B. Review the construction contract documents for Contractor submittals of draft checklists, draft test procedures, manufacturer startup procedures, and other information intended for the use of the Commissioning Authority in preparing the Commissioning Plan.
- C. Commissioning Schedule:
 - 1. Coordinate with Contractor anticipated dates of startup of each item of equipment and system.
 - 2. Contractor's scheduling responsibilities are specified in the construction contract documents.
 - 3. Revise and re-issue schedule monthly.
 - 4. Prefunctional Checklists and Functional Tests are to be performed in sequence from components, to subsystems, to systems.
 - 5. Deliver relevant Prefunctional Checklists and Functional Test Procedures to Contractor in time to avoid delay.

D. Commissioning Team: Project manager or other designated person of:

1. Owner's building or plant operation staff.
2. Commissioning Authority.
3. Construction Manager.
4. Design professional's design team.
5. General Contractor.
6. HVAC subcontractor.
7. HVAC control system subcontractor.
8. HVAC testing, adjusting, and balancing (TAB) subcontractor.
9. Electrical subcontractor.
10. Plumbing subcontractor.
11. Communications subcontractor.

3.02 CONSTRUCTION CONTRACT DOCUMENTS

- A. General Commissioning Specifications: Architect has prepared general commissioning specifications for inclusion in the construction contract documents; review and submit comments to Owner.
1. These specifications include:
 - a. Procedures applicable to all types of items to be commissioned.
 2. Prepare specifications for any of the following that would be recommended, for incorporation into the construction contract documents by Architect:
 - a. Additional Contractor submittals needed for purposes of commissioning, such as startup procedures, draft test procedures, draft training plans, etc.
 - b. Additional Owner personnel training.
 - c. Additional operation or maintenance data that should be submitted.
- B. Prefunctional Checklists: Develop detailed Checklists for each item to be commissioned.
1. List of Checklists to be Developed: Prepare and maintain a detailed list of titles, not full text.
 2. The Checklist forms are intended to be part of the Contractor's Contract Documents.

- C. Functional Testing: Develop detailed procedures for each item to be commissioned; submit for review by Owner and Architect.
 - 1. List of Test Procedures to be Developed: Prepare and maintain a detailed list of titles, not full text.
 - 2. The forms the Commissioning Authority will use to report Functional Test results are not intended to be part of Contractor's Contract Documents, but the Functional Test Procedures that must be executed by the Contractor must be made part of the Contract Documents, by modification if necessary.
- D. Develop any other reporting forms Contractor will be required to use; if they are likely to require a substantially different amount of work than the Contractor can reasonably anticipate, they must be included in the construction contract documents.
- E. If any part of the documents described above have not been developed by the bid date, coordinate with Architect the issuance of modifications to the construction contract documents

3.03 PREFUNCTIONAL CHECKLISTS

- A. Prefunctional Checklists - Content: Prepare forms for Contractor's use, in sufficient detail to document that the work has been installed in accordance with the Contract Documents and the manufacturer's recommendations and instructions, and that it receives adequate operational checkout prior to startup.
 - 1. Prepare separate Checklists for each type of equipment, system, or other assembly, customized to the item.
 - 2. Identify each Checklist by using the contract documents identification number or name, if any; if none, create unique identifiers for each Checklist; do not rely on Contractor to number checklists.
 - 3. Multiple identical or near-identical items may appear on a single Checklist provided there is space to record all required data for each separately; label each set of data uniquely.
 - 4. Include space to record manufacturer name, model number, serial number, capacity and other relevant characteristics, and accessories and other features as applicable; include space to record "as specified", "as submitted", and "as installed" data.
 - 5. Include space to record whether or not the required submittals have been received; list each separate type of submittal.
 - 6. Include line items for each physical inspection to be performed.
 - 7. Include line items for each operational inspection to be performed, such as checking switch operation, fan rotation, valve and damper stroke, and measuring actual electrical loads.

8. Include separate section for sensors and actuators, with space for documenting actual physical location and calibration measurements; provide a separate generic calibration checklist identified wherever referenced.
9. Include spaces to record that related Checklists for related work upon which this work depends have been completed.

B. Prefunctional Checklists - Format:

1. Provide a cover sheet showing name of equipment item or system, documentation identification number (see Documentation Identification Scheme), names of accessory components involved, and identification of related checklists.
2. Include on cover sheet space for Contractor's use in attesting to completeness; provide spaces for the signatures of the general contractor and each subcontractor or other entity responsible, customized to the project and the type of item.
3. Include on the cover sheet, above the signature block, the following statement:
"The work referenced in this Checklist and other work integral to or dependent on this work is complete and ready for functional testing. The checklist items are complete and have been checked off only by parties having direct knowledge of the event." Include two checkboxes:
 - a. "This Checklist is submitted for approval with no exceptions."
 - b. "This Checklist is submitted for approval, subject to the attached list of outstanding items, none of which preclude the performance of safe and reliable functional tests. A statement of completion will be submitted upon completion of the outstanding items."
4. Use a consistent, tabular format for all Checklists, with one line per checklist activity.
5. For each line item, provide space for initials and date, and identification of the subcontractor or other entity responsible.

3.04 FUNCTIONAL TEST PROCEDURES

- A. Develop test procedures in sufficient detail to show that functional performance is in accordance with the Contract Documents and shows proper operation through all modes of operation where there is a different system response, including seasonal, unoccupied, warm-up, cool-down, part- and full-load.
 1. Obtain assistance and review by installing subcontractors.
 2. Itemize each test sequence in step-by-step order, with acceptance criteria for each step and for the test as a whole.

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3. Include test setup instructions, description of tools and apparatus, special cautions, and.
 4. Avoid procedures that would void or otherwise limit warranties; review with Contractor prior to execution.
 5. For HVAC systems, procedures may include energy management control system trending, stand-alone datalogger monitoring or manual functional testing.
 6. Obtain explicit approval of Contractor in regard to feasibility and safety prior to execution.
- B. Functional Test Report Forms: Prepare forms in advance of testing, using a consistent format; include all test procedure information given to Contractor and:
1. Report Identifier (see Documentation Identification Scheme).
 2. Test prerequisites.
 3. Formulas to be used in calculations.
 4. Yes/No check boxes for each step of test.
 5. Space to record results, document deficiencies, and make recommendations.
 6. Signature and date block for Commissioning Authority.
- C. Functional Test Prerequisites: Include space to verify all of the following items on each Functional Test Report Form, unless truly inapplicable:
1. All related equipment has been started up and start-up reports and Prefunctional Checklists submitted and approved ready for Functional Testing.
 - a. For hydronic systems, check that:
 - 1) Piping system flushing is complete and required report approved.
 - 2) Water treatment system is complete and operational.
 - 3) Test and balance (TAB) is complete and approved.
 2. All control system functions for this and all interlocking systems are programmed and operable in accordance with the Contract Documents, including final set points and schedules with debugging, loop tuning and sensor calibrations completed, with space for signature of controls installer.
 3. Incomplete items identified by Architect during closeout inspections have been corrected or completed.
 4. Safeties and operating ranges have been reviewed.
 5. A copy of the specified sequence of operation is attached.

6. A copy of applicable schedules and setpoints is attached.
7. A copy of the specified Functional Test Procedures is attached.
8. The Functional Test Procedures have been reviewed and approved by the applicable installer.
9. Vibration control report approved (if required).
10. False loading equipment, system and procedures ready.
11. Sufficient clearance around equipment for servicing.
12. Original values of pre-test setpoints that need to be changed to accommodate testing have been recorded, with a check box provided to verify return to original values (include control parameters, limits, delays, lockouts, schedules, etc.).
13. Any other items on the Prefunctional Checklist or Start-up Reports that need to be re-verified.

3.05 CONSTRUCTION PHASE

- A. Coordinate the commissioning work with Contractor and Construction Manager; ensure that commissioning activities are being incorporated into the master schedule.
- B. Perform site visits, as necessary, to observe component and system installations. Attend planning and job-site meetings to obtain information on construction progress. Review Contractor's meeting minutes for issues relating to the commissioning process. Assist in resolving discrepancies.
- C. Commissioning Kick-Off Meeting: Plan and conduct a meeting early in the construction phase to review commissioning activities and responsibilities with all parties involved. Require attendance by all members of the Commissioning Team.
- D. Conduct periodic meetings as necessary to coordinate, resolve planning issues, and aid in resolution of deficiencies, minimizing the time spent by Contractor and Owner personnel; hold meetings at least monthly.
- E. Submit periodic progress reports to Owner and Contractor.
- F. Review Contractor shop drawing submittals applicable to systems being commissioned for compliance with commissioning needs; verify that Owner's responsibilities are clearly defined in warranties.
- G. Review and approve submittals directly related to commissioning.
- H. Deliver Prefunctional Checklists and Functional Test procedures to Contractor.
- I. Verify satisfactory completion of Prefunctional Checklists by Contractor by reviewing checklists and by site observation and spot checking; provide formal approval when satisfactory.

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- J. Verify startup of all systems by reviewing start-up reports and by site observation; provide formal approval when satisfactory.
- K. Coordinate, witness and approve Functional Tests performed by Contractor. Coordinate retesting until satisfactory performance is achieved.
- L. HVAC Commissioning:
 - 1. Gather and review the control sequences and interlocks and work with Contractor and design engineers until sufficient clarity has been obtained, in writing, to be able to prepare detailed Functional Test procedures.
 - 2. Witness all or part of HVAC piping test and flushing procedures, sufficient to be confident that proper procedures were followed; document testing and include documentation in O&M manuals.
 - 3. Witness all or part of duct testing and cleaning procedures, sufficient to be confident that proper procedures were followed; document testing and include documentation in O&M manuals.
 - 4. Review TAB Plan prepared by Contractor.
 - 5. Before TAB is executed, witness sufficient Functional Testing of the control system to approve it to be used for TAB.
 - 6. Verify air and water systems balancing by spot testing, by reviewing completed reports, and by site observation; provide formal approval when satisfactory.
 - 7. Analyze trend logs and monitoring data to verify performance.
- M. Witness and document testing of systems and components over which the Commissioning Authority does not have direct control, such as smoke control systems, tests contracted directly by Owner, and tests by manufacturer's personnel; include documentation in O&M manuals.
- N. When Functional Testing for specific systems or equipment is specified to be performed by the Commissioning Authority rather than the Contractor, perform such testing without assistance of Contractor.
- O. Maintain a master deficiency and resolution log and a separate testing record. Provide written progress and test reports with recommended actions.
- P. O&M Data: Review submitted operation and maintenance data for completeness; provide formal approval if satisfactory.
- Q. Notify Contractor and Owner of deficiencies in procedures or results; suggest solutions.

3.06 TRAINING

- A. Training Plan: Prepare a comprehensive Training Plan, incorporating draft training plans submitted by Contractor.

1. Include a [] hour session by the HVAC design engineer covering the overall HVAC system and equipment design concepts, with one-line schematic drawings.
 2. Include a [] hour session by the Commissioning Authority on the use of the blank Prefunctional Checklists and Functional Test report forms for re-commissioning purposes.
 3. Establish criteria for determining satisfactory completion of training.
- B. Verify that training was satisfactorily completed; provide formal approval if satisfactory.
- C. Contractor will perform video recording of training sessions.

3.07 CLOSEOUT

- A. Commissioning Record: Use the same format and organization as specified for the O&M manuals.
1. Include the Final Commissioning Plan and Final Report.
 2. For each product or system and equipment item, include the following organized as indicated, with separator tabs:
 - a. Design intent documentation, furnished by Architect or others.
 - b. Detailed operational sequences.
 - c. Startup plan and approved startup reports.
 - d. Filled out Prefunctional Checklists.
 - e. Filled out Functional Test reports; trend logs and monitoring reports and analysis; other verification documentation.
 - f. Training plan and training records.
 - g. Recommissioning recommendations, including time schedule and procedures; include blank copies of all Prefunctional Checklists and Functional Test report forms.
- B. Final Commissioning Report: Include:
1. Executive summary.
 2. List of participants and roles.
 3. Brief facility description.
 4. Overview of commissioning scope and general description of testing and verification methods.
 5. For each item commissioned, an evaluation of adequacy of:

- a. The product itself; i.e. compliance with the contract documents.
 - b. Installation.
 - c. Functional performance; include a brief description of the verification method used and observations and conclusions from the testing.
 - d. O&M documentation, including design intent.
 - e. Operator training.
6. List of all outstanding non-compliance items, referenced to the specific functional test, inspection, trend log, etc., where the deficiency is documented.
 7. List of unresolved issues, seasonal or deferred testing, and other concerns that could affect facility operation.
 8. Recommendations for improvement to equipment or operations, future actions, commissioning process changes, etc. (about four to six pages).
 9. Attach appendices containing all commissioning documentation, including logs, minutes, reports, deficiency lists, communications, findings, etc., except that specified to be part of the Commissioning Record.
- C. Recommissioning Manual: Revise the Commissioning Plan documents, checklists, and Functional Test forms as necessary based on accepted recommendations of the final Commissioning Report. Provide step-by-step instructions for recommissioning, blank forms, and cross-references to O&M data needed during recommissioning.

3.08 POST-OCCUPANCY PHASE

- A. Coordinate deferred and seasonal Functional Tests; verify correction of deficiencies.
- B. On-Site Review: 10 months after Substantial Completion conduct on-site review with Owner's staff.
 1. Review the current facility operation and condition of outstanding issues related to the original and seasonal commissioning.
 2. Interview staff to identify problems or concerns they have operating the facility as originally intended.
 3. Make suggestions for improvements and for recording these changes in the O&M manuals.
 4. Identify areas of concern that are still under warranty or are the responsibility of the original construction contractor.
 5. Assist facility staff in developing reports, documents and requests for services to remedy outstanding problems.

END OF SECTION

**SECTION 02 41 00
DEMOLITION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Selective demolition of building elements for alteration purposes.
- B. Abandonment and removal of existing utilities and utility structures.

1.02 REFERENCE STANDARDS

- A. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations 2013.
- B. CBC - California Building Code, California Code of Regulations, Title 24, Part 2, Chapter 33 Safeguards During Construction; Edition as indicated on Drawings.

1.03 SUBMITTALS

- A. See Section 01 33 00 - Shop Drawing, Product Data, and Samples for submittal procedures.
- B. Site Plan: Showing:
 - 1. Areas for temporary construction and field offices.
- C. Utility Access Plan: Showing:
 - 1. Locations of utility access through existing construction beyond the project area. Indicate type of existing construction to be patched and existing finish to be matched.
 - 2. Locations, quantity, and sizes of access panels required in existing construction.
 - 3. Proposed temporary barriers.
 - 4. Proposed infection control measures.
- D. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

1.04 QUALITY ASSURANCE

- A. Demolition Firm Qualifications: Company specializing in the type of work required.

PART 2 PRODUCTS -- NOT USED

PART 3 EXECUTION

3.01 SCOPE

- A. Remove other items indicated, for salvage, relocation, recycling, and demolition.
- B. Fill excavations, open pits, and holes in ground areas generated as result of removals, using specified fill; compact fill as required so that required rough grade elevations do not subside within one year after completion.

3.02 GENERAL PROCEDURES AND PROJECT CONDITIONS

- A. Comply with other requirements specified in Section 01 72 00.
- B. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
 - 1. Obtain required permits.
 - 2. Comply with applicable requirements of NFPA 241.
 - 3. Comply with applicable requirements of CBC, Chapter 33 Safeguards During Construction.
 - 4. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
 - 5. Provide, erect, and maintain temporary barriers and security devices.
 - 6. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
 - 7. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
 - 8. Do not close or obstruct roadways or sidewalks without permit.
 - 9. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.
 - 10. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon or limit access to their property.
- C. Do not begin removal until receipt of notification to proceed from Owner.
- D. Do not begin removal until built elements to be salvaged or relocated have been removed.

- E. Protect existing structures and other elements that are not to be removed.
 - 1. Provide bracing and shoring.
 - 2. Prevent movement or settlement of adjacent structures.
 - 3. Stop work immediately if adjacent structures appear to be in danger.
- F. If hazardous materials are discovered during removal operations, stop work and notify Architect and Owner; hazardous materials include regulated asbestos containing materials, lead, PCB's, and mercury.
- G. Perform demolition in a manner that maximizes salvage and recycling of materials.
 - 1. Dismantle existing construction and separate materials.
 - 2. Set aside reusable, recyclable, and salvageable materials; store and deliver to collection point or point of reuse.
- H. Partial Removal of Paving and Curbs: Neatly saw cut at right angle to surface.

3.03 EXISTING UTILITIES

- A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.
- B. Protect existing utilities to remain from damage.
- C. Do not disrupt public utilities without permit from authority having jurisdiction.
- D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.
- E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 7 days prior written notification to Owner.
- F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.
- G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.
- H. Prepare building demolition areas by disconnecting and capping utilities outside the demolition zone; identify and mark utilities to be subsequently reconnected, in same manner as other utilities to remain.

3.04 SELECTIVE DEMOLITION FOR ALTERATIONS

- A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.

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1. Verify that construction and utility arrangements are as indicated.
 2. Report discrepancies to Architect before disturbing existing installation.
 3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.
- B. Separate areas in which demolition is being conducted from other areas that are still occupied.
1. Provide, erect, and maintain temporary dustproof partitions of construction specified in Section 01 50 00 in locations indicated on drawings.
- C. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.
- D. Remove existing work as indicated and as required to accomplish new work.
1. Remove items indicated on drawings.
- E. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove existing systems and equipment as indicated.
1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components.
 2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
 3. Verify that abandoned services serve only abandoned facilities before removal.
 4. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification.
- F. Protect existing work to remain.
1. Prevent movement of structure; provide shoring and bracing if necessary.
 2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
 3. Repair adjacent construction and finishes damaged during removal work.
 4. Patch as specified for patching new work. Where patching is required in existing construction, match existing construction type and finish.

3.05 DEBRIS AND WASTE REMOVAL

- A. Remove debris, junk, and trash from site.

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- B. Leave site in clean condition, ready for subsequent work.
- C. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

**SECTION 03 54 00
CAST UNDERLAYMENT**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Concrete floor dormant crack remediation
- B. Concrete floor remediation for moisture control issues
- C. Concrete floor self-leveling underlayment for floor flatness remediation
- D. Concrete floor remediation for moisture control issues and self-leveling underlayment for floor flatness remediation
- E. Concrete floor sloping up to 1/2" thickness
- F. Concrete floor sloping greater than 1/2" thickness

1.02 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions
- B. Section 01 77 00 Closeout Procedures: Alteration project procedures; selective demolition for remodeling.
- C. Section 09 05 61 - Common Work Results in Flooring Preparation.

1.03 PRICE AND PAYMENT PROCEDURES

- A. Alternates : See Section 01 23 00 - Alternates.
 - 1. Unit Price for Remedial Floor Coating for Moisture Control: Do not include the cost of the floor coating or underlayment in the base bid; state on the bid form the unit price per square foot for the floor coating or underlayment, installed, in the event such remediation is required.

1.04 REFERENCE STANDARDS

- A. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens) 2016a.
- B. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete 2012.
- C. ASTM C348 - Standard Test Method for Flexural Strength of Hydraulic-Cement Mortars 2014.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2017.

- E. ICRI 310.2R - Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair 2013.

1.05 SUBMITTALS

- A. See Section 01 33 00 - Shop Drawings, Product Data and Samples, for submittal procedures.
- B. Product Data: Provide manufacturer's data sheets documenting physical characteristics and product limitations of underlayment materials. Include information on surface preparation, environmental limitations, and installation instructions.
- C. Certificate: Certify that products meet or exceed specified requirements.

1.06 QUALITY ASSURANCE

- A. Applicator Qualifications: Company specializing in performing the work of this section, and approved by manufacturer.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Keep dry and protect from direct sun exposure, freezing, and ambient temperature greater than 105 degrees F.

1.08 MOCK-UP

- A. Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
 - 1. Area: 6 ft by 6 ft.
- B. Mock-up may remain as part of the Work.

1.09 FIELD CONDITIONS

- A. Do not install underlayment until floor penetrations and peripheral work are complete.
- B. Maintain minimum ambient temperatures of 50 degrees F 24 hours before, during and 72 hours after installation of underlayment.
- C. During the curing process, ventilate spaces to remove excess moisture.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Cementitious Underlayment:
 - 1. Basis of Design:

- a. ARDEX Engineered Cements; ARDEX K 13: www.ardexamericas.com/#sle.
 - 1) Concrete floor dormant crack remediation: ARDEX Ardifix
 - 2) Concrete floor remediation for moisture control issues: ARDEX MC Rapid
 - 3) Concrete floor self-leveling underlayment for floor flatness remediation: ARDEX P51 primer, ARDEX K15
 - 4) Concrete floor remediation for moisture control issues and self-leveling underlayment for floor flatness remediation: Basecoat ARDEX MC Rapid, Top Coat ARDEX K15
 - 5) Concrete floor sloping up to 1/2" thickness: ARDEX Feather Finish
 - 6) Concrete floor sloping greater than 1/2" thickness: Rough lift - ARDEX P51 primer, AREDEX SD-P Rapid mixed with 1:1 washed pea gravel. Finish lift - ARDEX P51 primer, ARDEX SD-P Rapid or AREDEX Feather Finish.
2. Acceptable Manufacturers:
 - a. Custom Building Products: www.custombuildingproducts.com.
 - b. LATICRETE International, Inc: www.laticretesupercap.com/#sle.
 - c. Mapei Corporation: <http://www.mapei.com/>
3. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 MATERIALS

- A. General:
 1. Volatile Organic Compound (VOC) Content: Comply with Section .01 61 16 - Volatile Organic Compound (VOC) Content Restrictions
 2. Comply with applicable code for combustibility or flame spread requirements.
- B. Self-Leveling Cementitious Underlayment: Blended cement mix, that when mixed with water in accordance with manufacturer's directions will produce self-leveling underlayment with the following properties:
 1. Compressive Strength: Minimum 5,500 pounds per square inch after 28 days, tested per ASTM C109/C109M.
 2. Flexural Strength: Minimum 1200 psi after 28 days, tested per ASTM C348.
 3. Thickness: Capable of thicknesses from feather edge to maximum 1 1/2 inch over large areas and to a maximum of 5 inches with aggregate.

4. Surface Burning Characteristics: Flame spread/Smoke developed index of 0/0 in accordance with ASTM E84.
- C. Trowelable Cementitious Underlayment: Blended cement mix, that when mixed with water in accordance with manufacturer's directions will produce self-leveling underlayment with the following properties:
 1. Compressive Strength: Minimum 4200 psi after 28 days, tested per ASTM C109/C109M.
 2. Flexural Strength: Minimum 1000 psi after 28 days, tested per ASTM C348.
 3. Thickness: Capable of thicknesses from feather edge to maximum 1 1/2 inch over large areas and to a maximum of 5 inches with aggregate.
 4. Surface Burning Characteristics: Flame spread/Smoke developed index of 0/0 in accordance with ASTM E84.
- D. Aggregate: Dry, well graded, washed pea gravel, size and type as recommended by manufacturer.
- E. Water: ASTM C1602/C1602M; clean, potable, and not detrimental to underlayment mix materials.
- F. Primer: Manufacturer's recommended type. Sand broadcast as recommended by manufacturer for the application.
- G. Joint and Crack Filler: Latex based filler, as recommended by manufacturer. Install in strict accordance with the manufacturer's installation instructions.

2.03 MIXING

- A. Site mix materials in accordance with manufacturer's instructions.
- B. Add aggregate for areas where thickness will exceed 1-1/2 inch. Mix underlayment and water for at least two minutes before adding aggregate, and continue mixing to assure that aggregate has been thoroughly coated.
- C. Mix to self-leveling consistency without over-watering.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces are clean, dry, unfrozen, do not contain petroleum byproducts, or other compounds detrimental to underlayment material bond to substrate.

3.02 PREPARATION

- A. Concrete: Prepare surfaces according to ICRI 310.2R, CSP 4.

- B. Remove substrate surface irregularities. Fill voids and deck joints with filler. Finish smooth.
- C. Vacuum clean surfaces.
- D. Prime substrate in accordance with manufacturer's instructions. Allow to dry.
- E. Close floor openings.

3.03 APPLICATION

- A. Install underlayment in accordance with manufacturer's instructions.
- B. Pump or pour material onto substrate. Do not retemper or add water.
 - 1. Pump, move, and screed while the material is still highly flowable.
 - 2. Be careful not to create cold joints.
 - 3. Wear spiked shoes while working in the wet material to avoid leaving marks.
- C. Place to required thickness, with top surface level to 1/8 inch in 10 ft.
- D. For final thickness over 1-1/2 inches, place underlayment in layers. Allow initial layer to harden to the point where the material has lost its evaporative moisture. Immediately prime and begin application of the subsequent layer within 24 hours.
- E. Place before partition installation.
- F. Where additional aggregate has been used in the mix, add a top layer of neat mix (without aggregate), if needed to level and smooth the surface.
- G. If a fine, feathered edge is desired, steel trowel the edge after initial set, but before it is completely hard.

3.04 CURING

- A. Once underlayment starts to set, prohibit foot traffic until final set has been reached.
- B. Air cure in accordance with manufacturer's instructions.

3.05 PROTECTION

- A. Protect against direct sunlight, heat, and wind; prevent rapid drying to avoid shrinkage and cracking.
- B. Do not permit traffic over unprotected floor underlayment surfaces.

END OF SECTION

**SECTION 05120
STRUCTURAL STEEL**

PART I - GENERAL

1.01 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 5 – MISCELLANEOUS METAL FABRICATIONS
 - 2. Division 9 - PAINTING for surface preparation and priming requirements.

1.02 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Engineer structural steel connections required by the Contract Documents to be selected or completed by the fabricator to withstand design loadings indicated.
- B. Engineering Responsibility: Engage a fabricator who utilizes a qualified professional engineer to prepare calculations, Shop Drawings, and other structural data for structural steel connections.

1.03 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. Shop primers.

1.04 QUALITY ASSURANCE

- A. Fabricator must participate in the AISC Quality Certification Program and be designated an AISC-Certified Plant as follows:
 - 1. Category: BU
- B. Comply with applicable provisions of the following specifications and documents:
 - 1. AISC Steel Construction Manual 16th edition
 - 2. AISC 360 "Specification for Structural Steel Buildings"
 - 3. AISC 303 "Code of Standard Practice for Steel Buildings and Bridges"
 - 4. AISC 341 "Seismic Provisions for Structural Steel Buildings"
 - 5. ASTM A 6 (ASTM A 6M) "Specification for General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use."
 - 6. Research Council on Structural Connections' (RCSC) "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
 - 7. Research Council on Structural Connections' (RCSC) "Load and Resistance Factor Design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- 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.

1.05 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 II - PRODUCTS

2.01 MATERIALS

- A. Structural Steel Shapes, Plates, and Bars: As follows:
 - 1. Angles, Channels, S-shapes and Plates: ASTM A 36 (ASTM A 36M).
 - 2. Wide-flange and Tee-shapes: ASTM A992
- B. Cold-Formed Structural Steel Tubing: ASTM A 500, Grade B.
- C. Hot-Formed Structural Steel Tubing: ASTM A 501.
- D. Steel Pipe: ASTM A 53, Type E or S, Grade B.
 - 1. Weight Class: Standard.
 - 2. Finish: Black.
- E. Carbon-Steel Castings: ASTM A 27, Grade 65-35 (ASTM A 27M, Grade 450-240), medium-strength carbon steel.
- F. Non high-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
- G. 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
 - a. Finish: Mechanically deposited zinc-coating, ASTM B 695, Class 50
- H. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, unless otherwise indicated, 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
- I. Welding Electrodes: Comply with AWS requirements.

2.02 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.

2.03 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. Mark and match-mark materials for field assembly.
 - 2. Fabricate for delivery a sequence that will expedite erection and minimize field handling of structural steel.
 - 3. Complete structural steel assemblies, including welding of units, before starting shop-priming operations.
 - 4. Comply with fabrication tolerance limits of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for structural steel.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
 - 1. Plane thermally cut edges to be welded.
- C. Finishing: Accurately mill ends of columns and other members transmitting loads in bearing.
- D. 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.
- E. 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.
- F. 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.
- G. 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.

2.04 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 325 (ASTM A 325M) 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.

2.05 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, non-asphaltic 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).

2.06 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.

2.07 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."
 - 4. Ultrasonic Inspection: ASTM E 164.
- 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.
- G. VOC compliance certificate signed by manufacturers certifying compliance of their products with regulations of authorities having jurisdiction over volatile organic compounds (VOCs).

PART III - EXECUTION

3.01 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.

3.02 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.

3.03 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."
 - 1. Maintain erection tolerances of architecturally exposed 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.

3.04 FIELD CONNECTIONS

- A. Install and tighten non-high-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 325 (ASTM A 325M) 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.

3.05 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."
 - 4. Ultrasonic Inspection: ASTM E 164.
- 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.

3.06 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 05120

**SECTION 05400
COLD-FORMED METAL FRAMING**

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. Interior non-load-bearing wall framing
 - 2. Ceiling joist framing

As shown and detailed on the Drawings and specified herein.

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.
- C. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code – Steel," and AWS D1.3, "Structural Welding Code – Sheet Steel."
- 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.
 1. Fire-Resistance Ratings: Indicated by GA File Numbers in GA-600, "Fire Resistance Design Manual," or by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.
- 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.
 1. CCFSS Technical Bulletin: "AISI Specification Provisions for Screw Connections."
- 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 (230)]**.
 - 2. Coating: **[G60 (Z180)]**.
 - 3. Grade: **[33 (230)]** or C, Type 1 or 2].

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: ASTM F 1554, Grade [36] [55], threaded carbon-steel [hex-headed] [headless, hooked] [headless, with encased end threaded,] bolts and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by [hot-dip process according to ASTM A 153/A 153M, Class C] [mechanically deposition according to ASTM B 695, Class 50].
- 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 Division 9 Section

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-resistive 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 $\frac{1}{8}$ " (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 05400

**SECTION 05410
METAL STUD SYSTEM**

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. Division 9 – GYPSUM BOARD

1.02 SUBMITTALS

- A. General: Refer to Section 01330 – 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 01310 – COORDINATION.

1.04 MAINTENANCE

- A. General: Refer to Section 01770 – 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: ClarkDietrich Building Systems, CEMCO, or approved 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 minimum 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. 20ga electro-galvanized steel sheet, roll-formed, HAT: 2- $\frac{3}{4}$ " x $\frac{7}{8}$ " deep with $\frac{1}{2}$ " wide flanges.
 - b. Zee: 1- $\frac{1}{2}$ " x 1- $\frac{1}{2}$ ".
 - c. 20ga electro-galvanized sheet, roll-formed. Resilient RC channels.
2. Floor runners or C-Track: 16ga Un-punched track.
3. Top Runner or Slotted Track: 16ga deep leg punched track.
4. Stud Stiffeners: $\frac{3}{4}$ " 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:

1. Expansion Anchors: Hilti, Inc. KB-TZ2, Simpson Strong-Tie Co. Inc. Strong-Bolt or equal with current ICC ES report.
2. Powder Driven Fasteners:
 - a. Hilti, Inc.; DS32P10 4.5mm diameter, 32mm shank carbon steel, zinc plated. Used with DX76.
 - b. Ramset, or equal with current ICC ES report.
3. Screws: Type S bugle head; sizes recommended by gypsum board manufacturer.

E. Wire Hangers: 12 gage galvanized soft steel wire.

F. Neoprene Tape: ASTM D1056, Grade SCE41, soft sponge neoprene with adhesive one side; black; $\frac{1}{4}$ " x $\frac{1}{2}$ ", unless otherwise shown.

PART III - EXECUTION

3.01 PREPARATION

- A. General: Refer to Section 01310 – 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:
 - 1. General: ANSI A97.2.
 - 2. Structural Studs: MLSFA (Metal Lath/Steel Framing Association).
- B. Metal Stud Partitions:
 - 1. General: Install complete with matching runner tracks and accessories. Align runner tracks accurately to partition layouts.
 - 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 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:
 - 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 01740 – CLEANING.

END OF SECTION 05410

SECTION 05500
MISCELLANEOUS METAL FABRICATIONS

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. Division 5 – STRUCTURAL STEEL

1.02 QUALITY ASSURANCE

- A. References:
 - 1. 2019 California Building Code (CBC)
 - 2. American Institute for Steel Construction (AISC): Steel Construction Manual, 16th Edition.
 - 3. American Welding Society (AWS): D1.1 Structural Welding Code
 - 4. National Association of Architectural Metal Manufacturers (NAAMM): Standards
 - 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 01330 – 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 01310 – 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 01770 – 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
 - A. 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
 - 5) Hilti KB-TZ2 expansion anchors per ICC ESR-4266
 - b) Rebar doweling into concrete

A. 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
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 Ferrosan, GPR, X-Ray, chipping or other means.

A. Non-Shrink Grout:

1. "Embco" manufactured by BASF Corporation
2. W.R. Meadows, Inc, or equal.

D. 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. Fasteners: As shown.

PART III - EXECUTION

3.01 PREPARATION

- A. General: Refer to Section 01310 – 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. 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 05500

SECTION 06 10 63
MISCELLANEOUS ROUGH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Concealed wood blocking, nailers, and supports.
- B. Miscellaneous wood nailers, furring, and grounds.

1.02 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.

1.03 REFERENCE STANDARDS

- A. PS 20 - American Softwood Lumber Standard 2021.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
 - 1. If no species is specified, provide species graded by the agency specified; if no grading agency is specified, provide lumber graded by grading agency meeting the specified requirements.
 - 2. Grading Agency: Grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee (www.alsc.org) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

- A. Select material sizes to minimize waste.
- B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.

3.02 BLOCKING, NAILERS, AND SUPPORTS

- A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.

3.03 CLEANING

- A. Do not leave wood, shavings, sawdust, etc. on the ground or buried in fill.

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B. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION

SECTION 06 41 00
ARCHITECTURAL WOOD CASEWORK

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Specially fabricated cabinet units.
- B. Cabinet hardware.
- C. Factory finishing.
- D. Preparation for installing utilities.

1.02 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 06 10 53 - Miscellaneous Rough Carpentry: Support framing, grounds, and concealed blocking.
- C. Section 12 36 00 - Countertops.

1.03 DEFINITIONS

- A. HPDL: High Pressure Decorated Laminate.
- B. LPDL: Low Pressure Decorative Laminate.
- C. NEMA: National Electrical Manufacturers Association.
- D. WI: Woodwork Institute.

1.04 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2022.
- B. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition 2014, with Errata (2016).
- C. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards 2021, with Errata.
- D. BHMA A156.9 - Cabinet Hardware 2020.
- E. NEMA LD 3 - High-Pressure Decorative Laminates 2005.
- F. WI (CCP) - Certified Compliance Program (CCP) Current Edition.
- G. WI (CSIP) - Certified Seismic Installation Program (CSIP) Current Edition.

H. WI (MCP) - Monitored Compliance Program (MCP) Current Edition.

1.05 SUBMITTALS

- A. See Section 01 33 00 - Shop Drawings, Product Data, and Sample, for submittal procedures.
- B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
 - 1. Scale of Drawings: 1-1/2 inch to 1 foot, minimum.
 - 2. Provide the information required by AWI/AWMAC/WI (AWS).
 - 3. Include certification program label.
 - 4. Provide schedule indicating casework identification symbols and locations.
 - 5. Use same reference numbers and details as the Drawings.
 - 6. Furnish elevations, sections and details showing standard construction and fabrication methods. Indicate materials, construction, finish and accessories.
 - 7. Show countertops as specified in Section 12 36 00.
 - 8. Indicate keying group where required.
 - 9. Indicate location and blocking for finish hardware.
 - 10. Indicate details for seismic anchorage.
- C. Product Data: Provide data for hardware accessories.

1.06 QUALITY ASSURANCE

- A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
 - 1. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.
- B. Quality Certification:
 - 1. For projects under OSHPD-1, OSHPD-2, or DSA jurisdiction, comply with WI (CSIP) woodwork association quality certification service/program in accordance with requirements for work specified in this section.
 - 2. Provide labels or certificates indicating that the installed work complies with AWMAC/WI (NAAWS) requirements for grade or grades specified.
 - 3. Provide designated labels on shop drawings as required by certification program.

4. Provide designated labels on installed products as required by certification program.
 5. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.
 6. Replace, repair, or rework all work for which certification is refused.
- C. Source Limitations; Obtain each type of architectural wood casework and accessories through one source from a single fabricator.

PART 2 PRODUCTS

2.01 CABINETS

- A. Quality Standard: Premium Grade, in accordance with AWMAC/WI (NAAWS), unless noted otherwise.
- B. Cabinets:
1. Finish - Exposed Exterior Surfaces: As indicated on Drawings.
 2. Finish - Exposed Interior Surfaces: As indicated on Drawings.
 3. Finish - Semi-Exposed Surfaces: As indicated on Drawings
 4. Finish - Concealed Surfaces: Manufacturer's option.
 5. Door and Drawer Front Edge Profiles: Square edge with thin applied band.
 6. Door and Drawer Front Retention Profiles: Fixed panel.
 7. Casework Construction Type: Type A - Frameless.
 8. Interface Style for Cabinet and Door: Style 1 - Overlay; reveal overlay.
 9. Layout for Cabinet and Door Fronts: Flush panel.
 - a. Premium Grade:
 - 1) Provide vertical run and match for doors, drawer fronts and false fronts within each cabinet unit.
 10. Cabinet Design Series: As indicated on drawings.
 11. Adjustable Shelf Loading: 50 lbs. per sq. ft.
 - a. Deflection: L/144.
 12. Cabinet Style: Flush overlay.
 13. Cabinet Doors and Drawer Fronts: Flush style.

14. Drawer Side Construction: Multiple-dovetailed.

15. Drawer Construction Technique: Dovetail joints.

2.02 WOOD-BASED COMPONENTS

A. Wood fabricated from old growth timber is not permitted.

2.03 LAMINATE MATERIALS

A. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications.

B. Provide specific types as follows:

1. Horizontal Surfaces: HGS, 0.048 inch nominal thickness, through color, colors as indicated, finish as indicated.
2. Vertical Surfaces: VGS, 0.028 inch nominal thickness, through color, colors as indicated, finish as indicated.
3. Flame Retardant Surfaces: HGF, 0.048 inch nominal thickness, through color, colors as indicated, finish as indicated.
 - a. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.
4. Cabinet Liner: CLS, 0.020 inch nominal thickness, [____], [____] color, finish as indicated.
5. Laminate Backer: BKL, 0.020 inch nominal thickness, undecorated; for application to concealed backside of panels faced with high pressure decorative laminate.

2.04 COUNTERTOPS

A. Countertops are specified in Section 12 36 00.

2.05 ACCESSORIES

A. Adhesive: Type recommended by WI to suit application.

B. Plastic Laminate Edge Banding: HGS, 0.048 inch nominal thickness.

1. Color: As indicated on drawings.
2. Use at all exposed edges.

C. Fasteners: Size and type to suit application.

D. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel or

chrome-plated finish in exposed locations.

- E. Concealed Joint Fasteners: Threaded steel.
- F. Grommets: Standard plastic grommets for cut-outs, in color to blend with adjacent surface.
 - 1. Manufacturers:
 - a. Doug Mockett & Company, Inc.; EDP Flip-Top Series: www.mockett.com.
 - b. HefeLe; 631.26 Cable Grommet; www.hefele.com.
 - c. Or equal.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
 - 2. Style: Round with matching, removable cap.
 - 3. Size: 2 1/2 inch diameter.
 - 4. Provide 1 grommet for each 36" of worksurface unless otherwise indicated on the drawings. To be field located by Architect.

2.06 HARDWARE

- A. Hardware: BHMA A156.9, types as indicated for quality grade specified.
- B. Shelf Supports: Standard
 - 1. Shelf-Support Clips: Knappe & Vogt No. 243 ZC, or equal.
 - 2. Shelf Standards: Knappe & Vogt No. 255 ZC, or equal.
- C. Drawer and Door Pulls: As indicated on drawings.
 - 1. Stainless steel, 9/16 inch square profile; DP105A Series by Doug Mockett & Company, Inc, or equal
 - a. Unless otherwise indicated, provide one for each door or drawer, two for each drawer
30 inches or wider.
 - b. Mounting Direction:
 - 1) Doors: Vertical
 - 2) Drawers: Horizontal
- D. Cabinet Locks: Keyed cylinder, two keys per lock, master keyed, steel with chrome finish.

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1. Product: Advantage Plus Pin Tumbler Cam Door & Drawer Cabinet Locks manufactured by CompX Security Products; www.compx.com or equal.
2. Coordinate keyway, keying, and key groups with Owner's lock shop.

E. Drawer Slides:

1. Type: Full extension.
2. Static Load Capacity: Heavy Duty grade.
3. Mounting: Side mounted.
4. Stops: Integral type.
5. Features: Provide self closing/stay closed type.
6. Manufacturers:
 - a. Accuride International, Inc; []: www accuride.com/#sle.
 - b. Knappe & Vogt Manufacturing Company; []:
www.knappeandvogt.com/#sle.

F. Hinges: European style concealed self-closing type, BHMA No. A156.9, B01601, steel with satin finish.

1. Manufacturers:
 - a. Häfele America Co.: www.hafele.com.
 - b. Blum, Inc: www.blum.com.

G. Bumper Pads (Silencers): Hemispherical, quiet clear type, 55 Shore A hardness; 3M Bump-on Protective Products, or accepted equal.

H. Wall Mounted Vanity Support Brackets:

1. Manufacturers:
 - a. Rangine Corporation; RAKKS EHV Series Vanity Support Bracket: www.rakks.com.
 - b. Chemical Concepts; ADA Vanity Bracket: www.counterbalanceshop.com.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
2. Type: Surface mounted with ADA compliant panel supports.
3. Removeable Panels: Provide removeable panel to conceal piping. Match adjacent casework for panel construction and finish. Provide concealed mounting hardware where available. Where concealed mounting hardware not available from bracket

manufacturer, provide Removeable Panel Dismountable Connectors.

4. Size: As recommended by manufacturer for size of vanity indicated on the drawings.
5. Load Capacity per bracket: 400 pounds.
6. Spacing and attachment: As recommended by the manufacturer for the size of counter indicated on the drawings. Provide equal and balanced spacing and coordinate locations with under-counter plumbing and components.
7. Backing: Coordinate stud locations or provide backing as indicated on the drawings.

2.07 FABRICATION

- A. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.
- B. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.
- C. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.
- D. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs.
 1. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.
 2. Cap exposed plastic laminate finish edges with material of same finish and pattern.
 3. Conceal means of fastening various items together per AWI/AWMAC/WI (AWS) requirements.
- E. Mechanically fasten back splash to countertops per AWI requirements at 16 inches on center.
- F. Provide cutouts for plumbing fixtures, inserts, appliances, outlet boxes, and fixtures and fittings. Verify locations of cutouts from on-site dimensions. Prime paint cut edges.
- G. Finish Hardware:
 1. Fit hardware accurately and install in compliance with hardware manufacturer's printed instructions.
 2. Accurately fit doors and drawers with uniform clearance at edges.

- 3. Doors and drawers shall operate freely, but not loosely, without sticking or binding, with hardware adjusted and functioning properly.
- H. Assemblies must be free of open joints, hammer and machine marks, structural defects and surface blemishes.

2.08 SHOP FINISHING

- A. Finish work in accordance with AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified:

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify adequacy of backing and support framing.
- B. Verify location and sizes of utility rough-in associated with work of this section.
- C. Verify that openings are properly framed, are true to line, plumb, square and within allowable tolerances.
- D. Reject work that does not conform to the manufacturer's installation requirements.
- E. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- F. Perform or arrange for required remedial work necessary to correct deficient conditions and to conform to fabricator's requirements.
- G. Proceed with the Work only after fabricator's acceptance of existing conditions.

3.02 INSTALLATION

- A. Install work in accordance with AWMAC/WI (NAAWS) requirements for grade indicated.
- B. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.
- C. Use fixture attachments in concealed locations for wall mounted components.
- D. Use concealed joint fasteners to align and secure adjoining cabinet units.
- E. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.
- F. Secure cabinets and counter bases to floor using appropriate angles and anchorages.
- G. Countersink anchorage devices at exposed locations. Conceal with solid wood plugs of species to match surrounding wood; finish flush with surrounding surfaces.

3.03 ADJUSTING

- A. Test installed work for rigidity and ability to support loads.
- B. Adjust moving or operating parts to function smoothly and correctly.
- C. Lubricate moving and operating parts as necessary to function properly and to provide a smooth, quiet operation, free from warp, twist or distortion.

3.04 CLEANING

- A. Clean casework, counters, shelves, hardware, fittings, and fixtures.
- B. Do not use cleaning materials or procedures that could change the appearance of exposed finishes or damage adjacent materials.
- C. Waste Management; After completing the Work, leave work areas free from debris, materials, equipment, and related items.

3.05 PROTECTION

- A. Protect items in place from sources of moisture, corrosion, deterioration, staining or other damage.
- B. Do not store anything adjacent to, on or against installed casework unless it is adequately protected.
- C. Do not use casework surfaces as work surfaces.
- D. Remove protection when it no longer needed and prior to Substantial Completion.

END OF SECTION

SECTION 07 14 00
FLUID-APPLIED WATERPROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fluid-Applied Waterproofing:
 - 1. Polyurethane waterproofing.
 - 2. Under-tile waterproofing and anti-fracture membrane.

1.02 RELATED REQUIREMENTS

- A. Section 03 54 00 Cast Underlayment
- B. Section 07 92 00 - Joint Sealants: Sealing moving joints in waterproofed surfaces that are not part of work in this section.
- C. Section 09 30 00 Tiling

1.03 REFERENCE STANDARDS

- A. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension 2016.
- B. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials 2016.
- C. NRCA (WM) - The NRCA Waterproofing Manual 2021.

1.04 SUBMITTALS

- A. See Section 01 33 00 - Shop Drawings, Product Data, and Samples, for submittal procedures.
- B. Shop Drawings: Indicate special joint or termination conditions and conditions of interface with other materials.
- C. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention, and acceptable installation temperatures.
- D. Warranty:
 - 1. Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
 - 2. Submit installer's certification that installation complies with warranty conditions for the waterproofing membrane.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.06 FIELD CONDITIONS

- A. Maintain ambient temperatures above 40 degrees F for 24 hours before and during application and until cured.

1.07 WARRANTY

- A. Contractor shall correct defective Work within a five year period after Date of Substantial Completion; remove and replace materials concealing waterproofing at no cost to Owner.
- B. Provide five year manufacturer warranty for waterproofing failing to resist penetration of water, except where such failures are the result of structural failures of building. Hairline cracking of concrete due to temperature change or shrinkage is not considered a structural failure.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design:
 - 1. Carlisle Coatings & Waterproofing, Inc: www.carlisleccw.com/sle.
- B. Acceptable Manufacturers;
 - 1. CETCO, a division of Minerals Technologies Inc: www.mineralstech.com/#sle.
 - 2. Gaco: <https://gaco.com/waterproofing/>
- C. Polyurethane Waterproofing:
 - 1. Carlisle Coatings & Waterproofing, Inc: www.carlisleccw.com/#sle.
 - 2. CETCO, a division of Minerals Technologies Inc: www.mineralstech.com/#sle.
 - 3. Gaco Western: www.gaco.com/#sle.
- D. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 WATERPROOFING APPLICATIONS

- A. Polyurethane Waterproofing:
 - 1. Location: As shown on drawings.
- B. Under-Tile Waterproofing and Anti-Fracture Membrane:

1. Location: As shown on drawings.

2.03 FLUID APPLIED WATERPROOFING MATERIALS

- A. Polyurethane Waterproofing: Cold-applied one or two component polyurethane, complying with ASTM C836/C836M.
 1. Cured Thickness: 60 mils, 0.060 inch, minimum.
 2. Suitable for installation over concrete substrates.
 3. Tensile Strength: 400 psi, measured in accordance with ASTM D412.
 4. Permeance: 0.073 perms, measured in accordance with ASTM E96/E96M.
 5. Products:
 - a. Carlisle Coatings & Waterproofing, Inc; CCW 703 Liquiseal: www.carlisleccw.com/#sle.
 - b. CETCO, a division of Minerals Technologies Inc; LDC 60: www.mineralstech.com/#sle.
 - c. Gaco Western; GacoFlex LM-60: www.gaco.com/#sle.
- B. Under-Tile Waterproofing and Anti-Fracture Membrane: Specifically designed for bonding to concrete, backer boards, and plywood under ceramic tile; complying with ANSI A118.10.
 1. Material: Trowel-applied water-based acrylic membrane, 25 mils, 0.025 inch thick, minimum, with continuous polyester fabric reinforcement.

2.04 ACCESSORIES

- A. Surface Conditioner: compatible with membrane compound; as recommended by membrane manufacturer.
- B. Sealant for Joints and Cracks in Substrate: Type compatible with waterproofing material and as recommended by waterproofing manufacturer.
- C. Drainage Panel: 1/4 inch thick formed plastic, hollowed sandwich.
 1. Product: Troba plus manufactured by Schluter.
- D. Counterflashings: As recommended by membrane and protection board manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.

- B. Verify substrate surfaces are free of frozen matter, dampness, loose particles, cracks, pits, projections, penetrations, or foreign matter detrimental to adhesion or application of waterproofing system.
- C. Verify that substrate surfaces are smooth, free of honeycomb or pitting, and not detrimental to full contact bond of waterproofing materials.
- D. Verify items that penetrate surfaces to receive waterproofing are securely installed.

3.02 PREPARATION

- A. Protect adjacent surfaces from damage not designated to receive waterproofing.
- B. Clean and prepare surfaces to receive waterproofing in accordance with manufacturer's instructions; vacuum substrate clean.
- C. Do not apply waterproofing to surfaces unacceptable to waterproofing manufacturer.
- D. Fill non-moving joints and cracks with a filler compatible with waterproofing materials.
- E. Prepare building expansion joints at locations as indicated on drawings.

3.03 INSTALLATION

- A. Install waterproofing to specified minimum thickness in accordance with manufacturers instructions and NRCA (WM) applicable requirements.
- B. Apply primer or surface conditioner at a rate recommended by manufacturer, and protect conditioner from rain or frost until dry.
- C. Extend waterproofing material and flexible flashing into drain clamp flange, apply adequate coating of liquid membrane to ensure clamp ring seal, and coordinate with drain installation requirements specified in Section 22 10 06.
- D. Seal membrane and flashings to adjoining surfaces.
 - 1. Install termination bar along edges.
 - 2. Install counterflashing over exposed edges.

3.04 INSTALLATION - DRAINAGE PANEL AND PROTECTION BOARD

- A. Place drainage panel directly against membrane, butt joints, place to encourage drainage downward, and scribe and cut boards around projections, penetrations, and interruptions.
- B. Place protection board directly against drainage panel; butt joints, and scribe and cut boards around projections, penetrations, and interruptions.

3.05 FIELD QUALITY CONTROL

- A. Upon completion of horizontal membrane installation, dam installation area in preparation for flood testing.
- B. Flood to minimum depth of 1 inch with clean water, and after 48 hours inspect for leaks.
- C. If leaking is found, remove water, repair leaking areas with new waterproofing materials as directed by Architect; repeat flood test, and repair damage to building.
- D. When area is proven watertight, drain water and remove dam.

3.06 PROTECTION

- A. Do not permit traffic over unprotected or uncovered membrane.

END OF SECTION

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**SECTION 07 21 00
THERMAL INSULATION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Batt insulation in interior wall assemblies.

1.02 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 07 84 00 - Firestopping: Insulation as part of fire-rated through-penetration assemblies.
- C. Section 09 21 16 - Gypsum Board Assemblies: Acoustic insulation inside walls and partitions.

1.03 REFERENCE STANDARDS

- A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus 2021.
- B. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications 2013 (Reapproved 2019).
- C. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation 2014 (Reapproved 2019).
- D. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing 2017.

1.04 SUBMITTALS

- A. See Section 01 33 00 - Shop Drawings, Product Data, and Samples, for submittal procedures.
- B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.

1.05 FIELD CONDITIONS

- A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

PART 2 PRODUCTS

2.01 APPLICATIONS

2.02 BATT INSULATION MATERIALS

- A. Acoustic Insulation: ASTM C665; preformed glass fiber, friction fit type, unfaced.
 - 1. Flame spread index of not more than 25 per ANSI/UL 723 Test for Surface Burning Characteristics
 - 2. Underwriters Laboratory (UL) Certification under category BKNV with designation FHC 25/50

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.
- B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.02 BATT INSTALLATION

- A. Install insulation and vapor retarder in accordance with manufacturer's instructions.
- B. Install in wall spaces without gaps or voids. Do not compress insulation.
- C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
- D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.

3.03 PROTECTION

- A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION

**SECTION 07 84 00
FIRESTOPPING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Firestopping systems.
- B. Firestopping of all joints and penetrations in fire resistance rated and smoke resistant assemblies, whether indicated on drawings or not, and other openings indicated.

1.02 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 09 21 16 - Gypsum Board Assemblies: Gypsum wallboard fireproofing.

1.03 REFERENCE STANDARDS

- A. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials 2022.
- B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems 2013a (Reapproved 2017).
- C. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems 2015 (Reapproved 2019).
- D. ASTM E2174 - Standard Practice for On-Site Inspection of Installed Firestop Systems 2020a.
- E. ASTM E2393 - Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers 2020a.
- F. ASTM E2307 - Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-story Test Apparatus 2020.
- G. ASTM E2837 - Standard Test Method for Determining the Fire Resistance of Continuity Head-of-Wall Joint Systems Installed Between Rated Wall Assemblies and Nonrated Horizontal Assemblies 2013 (Reapproved 2017).
- H. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi 2015, with Editorial Revision (2021).
- I. ITS (DIR) - Directory of Listed Products Current Edition.
- J. FM (AG) - FM Approval Guide current edition.
- K. SCAQMD 1168 - Adhesive and Sealant Applications 1989, with Amendment (2017).

- L. UL 1479 - Standard for Fire Tests of Penetration Firestops Current Edition, Including All Revisions.
- M. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems Current Edition, Including All Revisions.
- N. UL (DIR) - Online Certifications Directory Current Edition.
- O. UL (FRD) - Fire Resistance Directory Current Edition.
- P. Omega Point Laboratories Directory: current edition.

1.04 SUBMITTALS

- A. See Section Section 01 33 00 - Shop Drawings, Product Data, and Samples, for submittal procedures.
- B. Schedule of Firestopping: List each type of penetration, fire rating of the penetrated assembly, and firestopping test or design number.
- C. Product Data: Provide data on product characteristics, performance ratings, limitations, and manufacturer's specifications and technical data for each material including the composition and limitations, documentation of qualified tested firestop systems to be used.
- D. Sustainable Design Submittal: Submit VOC content documentation for all non-preformed materials.
- E. Manufacturer's Installation Instructions: Indicate preparation and installation instructions.
- F. Manufacturer's Engineering Judgment: Identification number and document details when no qualified tested system is available for an application. Engineering Judgment must include both project name and contractor's name who will install firestop system as described in document.
- G. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- H. Installer Qualification: Submit qualification statements for installing mechanics.
- I. Engineering Judgements (EJ): Where built conditions do not conform with an existing listed assembly, submit engineering analysis based on a comparison of building element, component or assemblies designs having fire-resistance ratings in accordance with UL 1479 or ASTM E814. Requirements for Engineering Judgements:
 - 1. Prepared and signed by a registered Professional Engineer or Fire Protection Engineer who shall be knowledgeable regarding the elements of the construction to be protected, probable behavior of that construction and the recommended system protecting it. Provide documentation of Engineer's qualifications.

2. Provide existing tested, listed systems that are comparable in application of cover equivalent conditions that shall be used as the basis for the EJ.
3. The EJ shall apply only to the specific conditions and configurations for which it was produced and shall be based upon reasonable performance expectations for the recommended fire-resistive system for the specific application.
4. EJs are approved for a specific condition on a project-by-project basis and shall not be used for another project or condition without thorough and appropriate review of all aspects of the EJ as it relates to that project's circumstances.
5. EJs shall be presented in a narrative format that clearly describes all aspects of the design, including, but not limited to the hourly rating required, a complete description of all critical elements for the fire-resistive system configuration, any non-standard conditions, clear directions for the installation of the recommended system and the fire-resistive design(s) that the EJ is based on. Detailed drawings shall be included when deemed necessary to clearly illustrate the assembly.
6. EJs shall clearly state that the recommended system is an engineering judgment and is NOT a listed system.
7. EJs shall indicate the facility name, address, title of project, AHJ project/permit number, and include the issuer's name, title, address, telephone number and signature.

1.05 QUALITY ASSURANCE

- A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.
 1. Listing in UL (FRD), FM (AG), or ITS (DIR) will be considered as constituting an acceptable test report.
 2. Valid evaluation report published by ICC Evaluation Service, Inc. (ICC-ES) at www.icc-es.org will be considered as constituting an acceptable test report.
 3. Submission of actual test reports is required for assemblies for which none of the above substantiation exists.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum ten years experience.
- C. Installer Qualifications: Company specializing in performing the work of this section and meeting any two of the following requirements:
 1. Trained by manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials undamaged in manufacturer's clearly labeled, unopened containers, identified with brand, type, and UL label where applicable.

- B. Coordinate delivery of materials with scheduled installation date to allow minimum storage time at job-site.
- C. Store materials under cover and protect from weather and damage in compliance with manufacturer's requirements, including temperature restrictions.
- D. Comply with recommended procedures, precautions or remedies described in material safety data sheets as applicable.
- E. Do not use damaged or expired materials.

1.07 FIELD CONDITIONS

- A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for three days after installation of materials.
- B. Weather conditions: 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.
- C. Do not use materials that contain flammable solvents.
- D. Schedule installation of firestopping after completion of penetrating item installation but prior to covering or concealing of openings.
- E. Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.
- F. During installation, provide masking and drop cloths to prevent firestopping materials from contaminating any adjacent surfaces.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design Manufacturer
 - 1. Hilti, Inc: www.us.hilti.com/#sle.
- B. Other Acceptable Firestopping Manufacturers:
 - 1. 3M Fire Protection Products: www.3m.com/firestop.
 - 2. Specified Technologies Inc: www.stifirestop.com/#sle.
 - 3. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS

- A. 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.

- B. Provide components for each firestopping system that are 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.
- C. Provide a round fire-rated cable management device whenever cables penetrate fire rated walls, where frequent cable changes and additions may occur and that meet the following requirements:
 - 1. Fire-Rated Cable Management Devices:
 - a. Corrugated steel tube with zinc coating, contain and inner plastic housing, intumescent material rings, and inner fabric smoke seal membrane
 - b. Sleeve Length: 12.4 inches.
 - c. Integrated intumescent firestop wrap strip materials sufficient to maintain the hourly rating of the barrier being penetrated.
 - d. Smoke seal fabric membrane or intumescent firestop plugs sufficient to achieve the L-Rating requirements of the barrier type.
 - e. Install device per the manufacturer's published installation instructions.
- D. Penetrations in Fire Resistance Rated Walls: Provide firestopping with ratings determined in accordance with UL 1479 or ASTM E814.
 - 1. F-Rating: Not less than the fire-resistance rating of the wall construction being penetrated.
- E. Penetrations in Horizontal Assemblies: Provide firestopping with ratings determined in accordance with UL 1479 or ASTM E814.
 - 1. F-Rating: Minimum of 1-hour rating, but not less than the fire-resistance rating of the floor construction being penetrated.
 - 2. T-Rating: When penetrant is located outside of a wall cavity, minimum of 1-hour rating, but not less than the fire-resistance rating of the floor construction being penetrated.
- F. Penetrations in Smoke Barriers: Provide firestopping with ratings determined in accordance with UL 1479 or ASTM E814.
 - 1. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at both ambient and elevated temperatures.

2.03 MATERIALS

- A. Firestopping Materials: Any materials meeting requirements.

- B. Volatile Organic Compound (VOC) Content: Provide products having VOC content lower than that required by SCAQMD 1168.
- C. Mold and Mildew Resistance: Provide firestoppping materials with mold and mildew resistance rating of zero(0) in accordance with ASTM G21.
- D. Rain and Water Resistance: Provide perimeter joint sealant tested in accordance with ASTM D 6904 with less than 1 hour tack free time as tested in accordance with ASTM C 679.
- E. Firestopping Materials are either cast-in-place (integral with concrete placement) or post installed. Provide cast-in-place firestop devices prior to concrete placement.
- F. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.
- G. Fire Ratings: Refer to drawings for required systems and ratings.

2.04 FIRESTOPPING ASSEMBLY REQUIREMENTS

- A. Perimeter Fire Containment Firestopping: Use system that has been tested according to ASTM E2307 to have fire resistance F Rating equal to required fire rating of floor assembly.
 - 1. Movement: Provide systems that have been tested to show movement capability as indicated.
 - 2. Temperature Rise: Provide systems that have been tested to show T Rating as indicated.
 - 3. Air Leakage: Provide systems that have been tested to show L Rating as indicated.
 - 4. Where floor assembly is not required to have a fire rating, provide systems that have been tested to show L Rating as indicated.
- B. Head-of-Wall Joint System Firestopping at Joints Between Fire-Rated Wall Assemblies and Non-Rated Horizontal Assemblies: Use system that has been tested according to ASTM E2837 to have fire resistance F Rating equal to required fire rating of floor or wall, whichever is greater.
 - 1. Movement: Provide systems that have been tested to show movement capability as indicated.
 - 2. Air Leakage: Provide systems that have been tested to show L Rating at smoke partitions and smoke barriers.
- C. Floor-to-Floor, Wall-to-Wall, and Wall-to-Floor Joints, Except Perimeter, Where Both Are Fire-Rated: Use system that has been tested according to ASTM E1966 or UL 2079 to have fire resistance F Rating equal to required fire rating of the assembly in which the joint occurs.

1. Movement: Provide systems that have been tested to show movement capability as indicated.
 2. Air Leakage: Provide systems that have been tested to show L Rating at smoke partitions and smoke barriers.
 3. Listing by FM (AG), ITS (DIR), UL (DIR), or UL (FRD) in their certification directories will be considered evidence of successful testing.
- D. Through Penetration Firestopping: Use system that has been tested according to ASTM E814 to have fire resistance F Rating equal to required fire rating of penetrated assembly.
1. Temperature Rise: Provide systems that have been tested to show T Rating as indicated.
 2. Air Leakage: Provide systems that have been tested to show L Rating at smoke partitions and smoke barriers.
 3. Listing by FM (AG), ITS (DIR), UL (DIR), or UL (FRD) in their certification directories will be considered evidence of successful testing.

2.05 FIRESTOPPING FOR FLOOR-TO-FLOOR, WALL-TO-FLOOR, AND WALL-TO-WALL JOINTS

- A. Concrete and Concrete Masonry Walls and Floors:
1. Floor to Floor Joints:
 - a. 2 Hour Construction: UL System FF-D-1013; Hilti CFS-SP WB Firestop Joint Spray and CP 672.
 2. Top of Wall Joints at Concrete/Concrete Masonry Wall to Concrete Over Metal Deck Floor:
 - a. 2 Hour Construction: UL System HW-D-0181; Hilti CFS-SP WB Firestop Joint Spray and CP 672.
 - b. 2 Hour Construction: UL System HW-D-1037; Hilti CFS-SP WB Firestop Joint Spray and CP 672.
 3. Top of Wall Joints at Concrete/Concrete Masonry Wall to Concrete Floor:
 - a. 3 Hour Construction: UL System HW-D-1058; Hilti CFS-SP WB Firestop Joint Spray and CP 672.
 - b. 2 Hour Construction: UL System HW-D-0268; Hilti CP 606 Flexible Firestop Sealant.
 4. Concrete/Concrete Masonry Wall to Wall Joint Systems That Have Movement Capabilities (Dynamic):

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- a. 2 Hour Construction: UL System WW-D-0017; Hilti CFS-SP WB Firestop Joint Spray and CP 672.
- b. 2 Hour Construction: UL System WW-D-0032; Hilti CP 606 Flexible Firestop Sealant.

B. Gypsum Board Walls:

- 1. Wall to Wall Joints That Have Movement Capabilities (Dynamic):
 - a. 2 Hour Construction: UL System WW-D-0067; Hilti CP 606 Flexible Firestop Sealant.
 - b. 1 Hour Construction: UL System WW-D-0067; Hilti CP 606 Flexible Firestop Sealant.
- 2. Top of Wall Joints at Underside of Steel Beam and Concrete Over Metal Deck Floor with Sprayed On Fireproofing:
 - a. 2 Hour Construction: UL System HW-D-0259; Hilti CFS-SP WB Firestop Joint Spray and CP 672.
 - b. 1 Hour Construction: UL System HW-D-0259; Hilti CFS-SP WB Firestop Joint Spray and CP 672.
- 3. Top of Wall Joints at Underside of Flat Concrete:
 - a. 2 Hour Construction: UL System HW-D-1068; Hilti CFS-SP WB Firestop Joint Spray and CP 672.
 - b. 2 Hour Construction: UL System HW-D-0757; Hilti CFS-TTS Top Track Seal.
 - c. 1 Hour Construction: UL System HW-D-1068; Hilti CFS-SP WB Firestop Joint Spray and CP 672.
 - d. 1 Hour Construction: UL System HW-D-0757; Hilti CFS-TTS Top Track Seal.
- 4. Top of Wall Joints at Concrete Over Metal Deck, Wall Parallel to Ribs:
 - a. 2 Hour Construction: UL System HW-D-0049; Hilti CFS-SP WB Firestop Joint Spray and CP 672.
 - b. 2 Hour Construction: UL System HW-D-0184; Hilti CP 606 Flexible Firestop Sealant.
 - c. 1 Hour Construction: UL System HW-D-0049; Hilti CFS-SP WB Firestop Joint Spray and CP 672.
 - d. 1 Hour Construction: UL System HW-D-0184; Hilti CP 606 Flexible Firestop Sealant.

5. Top of Wall Joints at Concrete Over Metal Deck, Wall Perpendicular to Ribs, Cut to Fit Ribs:
 - a. 2 Hour Construction: UL System HW-D-0045; Hilti CP 606 Flexible Firestop Sealant.
 - b. 1 Hour Construction: UL System HW-D-0045; Hilti CP 606 Flexible Firestop Sealant.
6. Top of Wall Joints at Concrete Over Metal Deck, Wall Perpendicular to Ribs, Not Cut to Fit:
 - a. 2 Hour Construction: UL System HW-D-0042; Hilti CFS-SP WB Firestop Joint Spray and CP 672.
 - 1) Option to use Hilti Speed Strips CP 767 or Hilti Speed Plugs CP 777.
 - b. 2 Hour Construction: UL System HW-D-0045; Hilti CP 606 Flexible Firestop Sealant.
 - 1) Option to use Hilti Speed Strips CP 767 or Hilti Speed Plugs CP 777.
 - c. 1 Hour Construction: UL System HW-D-0042; Hilti CFS-SP WB Firestop Joint Spray and CP 672.
 - 1) Option to use Hilti Speed Strips CP 767 or Hilti Speed Plugs CP 777.
 - d. 1 Hour Construction: UL System HW-D-0045; Hilti CP 606 Flexible Firestop Sealant.
 - 1) Option to use Hilti Speed Strips CP 767 or Hilti Speed Plugs CP 777.

2.06 FIRESTOPPING PENETRATIONS THROUGH CONCRETE AND CONCRETE MASONRY CONSTRUCTION

A. Blank Openings:

1. In Floors or Walls:
 - a. 2 Hour Construction: UL System C-AJ-0090; Hilti FS-ONE MAX Intumescent Firestop Sealant.

B. Penetrations Through Floors or Walls By:

1. Multiple Penetrations in Large Openings:
 - a. 3 Hour Construction: UL System C-AJ-8099; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - b. 3 Hour Construction: UL System C-AJ-8110; Hilti CFS-BL Firestop Block.

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- c. 2 Hour Construction: UL System C-AJ-8143; Hilti FS-ONE MAX Intumescent Firestop Sealant.
- 2. Bathtub Drains:
 - a. Up to 3 Hour Construction: UL System F-A-1037, F-A-1038, F-A-2094, or F-A-2095; Hilti CP 681 Tub Box Kit.
- 3. Uninsulated Metallic Pipe, Conduit, and Tubing:
 - a. 3 Hour Construction: UL System C-AJ-1184; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - b. 3 Hour Construction: UL System C-AJ-1226; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - c. 3 Hour Construction: UL System C-AJ-1421; Hilti FS-ONE MAX Intumescent Firestop Sealant or CP 604 Self-Leveling Firestop Sealant.
 - d. 3 Hour Construction: UL System C-AJ-1425; Hilti CFS-S SIL GG Firestop Silicone Sealant Gun-Grade.
 - e. 2 Hour Construction: UL System C-AJ-1226; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - f. 2 Hour Construction: UL System C-AJ-1425; Hilti CFS-S SIL GG Firestop Silicone Sealant Gun-Grade.
- 4. Uninsulated Non-Metallic Pipe, Conduit, and Tubing:
 - a. 3 Hour Construction: UL System C-AJ-2109; Hilti CP 643N/644 Firestop Collar.
 - b. 3 Hour Construction: UL System C-AJ-2220; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - c. 2 Hour Construction: UL System C-AJ-2167; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - d. 2 Hour Construction: UL System C-AJ-2109; Hilti CP 643N/644 Firestop Collar.
 - e. 2 Hour Construction: UL System C-BJ-2021; Hilti CP 643N Firestop Collar.
- 5. Electrical Cables Not In Conduit:
 - a. 3 Hour Construction: UL System C-AJ-3095; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - b. 3 Hour Construction: UL System C-AJ-3208; Hilti CP 618 Firestop Putty Stick.

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- c. 2 Hour Construction: UL System C-AJ-3216; Hilti CFS-PL Firestop Plug.
 - d. 2 Hour Construction: UL System C-AJ-3283; Hilti CP653 Speed Sleeve.
 - e. 2 Hour Construction: UL System W-J-3198; Hilti CFS-SL RK Retrofit Sleeve Kit for existing cables.
 - f. 2 Hour Construction: UL System W-J-3199; Hilti CFS-SL SK Firestop Sleeve Kit.
6. Cable Trays with Electrical Cables:
- a. 3 Hour Construction: UL System C-AJ-4093; Hilti CFS-BL Firestop Block.
 - b. 2 Hour Construction: UL System C-AJ-4094; Hilti CFS-BL Firestop Block.
7. Electrical Busways:
- a. 3 Hour Construction: UL System C-AJ-6017; Hilti FS-ONE MAX Intumescent Firestop Sealant.
8. Insulated Pipes:
- a. 3 Hour Construction: UL System C-AJ-5090; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - b. 2 Hour Construction: UL System C-AJ-5048; Hilti FS-ONE MAX Intumescent Firestop Sealant, CP 606 Flexible Firestop Sealant, CP 601S Elastomeric Firestop Sealant, CP 604 Self-Leveling Firestop Sealant or CFS-S SIL GG Firestop Silicone Sealant Gun-Grade.
9. HVAC Ducts, Uninsulated:
- a. 3 Hour Construction: UL System C-AJ-7051; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - b. 2 Hour Construction: UL System C-AJ-7111; Hilti FS-ONE MAX Intumescent Firestop Sealant.
- C. Penetrations Through Floors By:
- 1. Multiple Penetrations in Large Openings:
 - a. 3 Hour Construction: UL System F-A-1023; Hilti CP 680-P/M Cast-In Device.
 - b. 2 Hour Construction: UL System F-A-8012; Hilti CFS-S SIL GG Firestop Silicone Sealant Gun-Grade or CFS-S SIL SL Firestop Silicone Sealant Self-Leveling.
 - 2. Uninsulated Metallic Pipe, Conduit, and Tubing:
 - a. 3 Hour Construction: UL System F-A-1017; Hilti CP 680-P/M Cast-In Device.

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- 1) Add Aerator Adaptor when used in conjunction with aerator system.
 - b. 2 Hour Construction: UL System F-A-1016; Hilti CP 680-P/M Cast-In Device.
 - 1) Add Aerator Adaptor when used in conjunction with aerator system.
 3. Uninsulated Non-Metallic Pipe, Conduit, and Tubing:
 - a. 3 Hour Construction: UL System F-A-2054; Hilti CP 680-P Cast-In Device.
 - 1) Add Aerator Adaptor when used in conjunction with aerator system.
 - b. 3 Hour Construction: UL System F-A-2066; Hilti CP 680-P Cast-In Device.
 - 1) Add Aerator Adaptor when used in conjunction with aerator system.
 - c. 3 Hour Construction: UL System F-A-2213; Hilti CFS-DID Drop-In Device.
 - d. 2 Hour Construction: UL System F-A-2065; Hilti CP 680-P Cast-In Device.
 - 1) Add Aerator Adaptor when used in conjunction with aerator system.
 - e. 2 Hour Construction: UL System F-A-2213; Hilti CFS-DID Drop-In Device.
 - f. 2 Hour Construction: UL System F-A-2053; Hilti CP 680-P Cast-In Device.
 - 1) Add Aerator Adaptor when used in conjunction with aerator system.
 4. Electrical Cables Not In Conduit:
 - a. 3 Hour Construction: UL System F-A-3033; Hilti CP 680-P/M Cast-In Device.
 - b. 2 Hour Construction: UL System F-A-3033; Hilti CP 680-P/M Cast-In Device.
 5. Electrical Busways:
 - a. 3 Hour Construction: UL System C-AJ-6017; Hilti CFS-S SIL GG Firestop Silicone Sealant Gun-Grade or CFS-S SIL SL Firestop Silicone Sealant Self-Leveling.
 6. Insulated Pipes:
 - a. 3 Hour Construction: UL System F-A-5016; Hilti CP 680-P Cast-In Device.
 - b. 3 Hour Construction: UL System F-A-5018; Hilti CP 680-P Cast-In Device.
 - c. 2 Hour Construction: UL System F-A-5015; Hilti CP 680-P/M Cast-In Device.
 - d. 2 Hour Construction: UL System F-A-5017; Hilti CP 680-P/M Cast-In Device.
- D. Penetrations Through Walls By:
1. Uninsulated Metallic Pipe, Conduit, and Tubing:

- a. 2 Hour Construction: UL System W-J-1067; Hilti FS-ONE MAX Intumescent Firestop Sealant.
- b. 1 Hour Construction: UL System W-J-1067; Hilti FS-ONE MAX Intumescent Firestop Sealant.
- 2. Electrical Cables Not In Conduit:
 - a. 2 Hour Construction: UL System C-AJ-3095; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - b. 2 Hour Construction: UL System C-AJ-3216; Hilti CFS-PL Firestop Plug.
- 3. Insulated Pipes:
 - a. 2 Hour Construction: UL System C-AJ-5090; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - b. 2 Hour Construction: UL System C-AJ-5091; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - c. 1 Hour Construction: UL System C-AJ-5090; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - d. 1 Hour Construction: UL System C-AJ-5091; Hilti FS-ONE MAX Intumescent Firestop Sealant.
- 4. HVAC Ducts, Uninsulated:
 - a. 2 Hour Construction: UL System W-J-7109; Hilti FS-ONE MAX Intumescent Firestop Sealant or CP 606 Flexible Firestop Sealant.
- 5. HVAC Ducts, Insulated:
 - a. 2 Hour Construction: UL System W-J-7112; Hilti FS-ONE MAX Intumescent Firestop Sealant.

2.07 FIRESTOPPING PENETRATIONS THROUGH GYPSUM BOARD WALLS

- A. Blank Openings:
 - 1. 2 Hour Construction: UL System W-L-3334; Hilti CP 653 Speed Sleeve.
 - 2. 1 Hour Construction: UL System W-L-3334; Hilti CP 653 Speed Sleeve.
- B. Penetrations By:
 - 1. Multiple Penetrations in Large Openings:
 - a. 2 Hour Construction: UL System W-L-1408; Hilti FS-ONE MAX Intumescent Firestop Sealant.

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- b. 2 Hour Construction: UL System W-L-8013; Hilti CFS-BL Firestop Block.
 - c. 2 Hour Construction: UL System W-L-8071; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - d. 2 Hour Construction: UL System W-L-8079; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - e. 1 Hour Construction: UL System W-L-1408; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - f. 1 Hour Construction: UL System W-L-8013; Hilti CFS-BL Firestop Block.
 - g. 1 Hour Construction: UL System W-L-8071; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - h. 1 Hour Construction: UL System W-L-8079; Hilti FS-ONE MAX Intumescent Firestop Sealant.
2. Uninsulated Metallic Pipe, Conduit, and Tubing:
- a. 2 Hour Construction: UL System W-L-1054; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - b. 2 Hour Construction: UL System W-L-1164; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - c. 2 Hour Construction: UL System W-L-1506; Hilti CFS-D Firestop Cable Disc.
 - d. 1 Hour Construction: UL System W-L-1054; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - e. 1 Hour Construction: UL System W-L-1164; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - f. 1 Hour Construction: UL System W-L-1506; Hilti CFS-D Firestop Cable Disc.
3. Uninsulated Non-Metallic Pipe, Conduit, and Tubing:
- a. 2 Hour Construction: UL System W-L-2078; Hilti CP 643N/644 Firestop Collar.
 - b. 2 Hour Construction: UL System W-L-2128; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - c. 1 Hour Construction: UL System W-L-2078; Hilti CP 643N/644 Firestop Collar.
 - d. 1 Hour Construction: UL System W-L-2128; Hilti FS-ONE MAX Intumescent Firestop Sealant.
4. Electrical Cables Not In Conduit:

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- a. 2 Hour Construction: UL System W-L-3065; Hilti FS-ONE MAX Intumescent Firestop Sealant, CP 606 Flexible Firestop Sealant, CD 601S Elastomeric Firestop Sealant, or CP 618 Firestop Putty Stick.
 - b. 2 Hour Construction: UL System W-L-3334; Hilti CP 653 Speed Sleeve.
 - c. 2 Hour Construction: UL System W-L-3393; Hilti CFS-SL RK Retrofit Sleeve Kit for existing cables.
 - d. 2 Hour Construction: UL System W-L-3395; Hilti CP653 Speed Sleeve.
 - e. 2 Hour Construction: UL System W-L-3414; Hilti CFS-D Firestop Cable Disc.
 - f. 1 Hour Construction: UL System W-L-3065; Hilti FS-ONE MAX Intumescent Firestop Sealant, CP 606 Flexible Firestop Sealant, CD 601S Elastomeric Firestop Sealant, or CP 618 Firestop Putty Stick.
 - g. 1 Hour Construction: UL System W-L-3334; Hilti CP 653 Speed Sleeve.
 - h. 1 Hour Construction: UL System W-L-3393; Hilti CFS-SL RK Retrofit Sleeve Kit for existing cables.
 - i. 1 Hour Construction: UL System W-L-3414; Hilti CFS-D Firestop Cable Disc.
5. Cable Trays with Electrical Cables:
- a. 2 Hour Construction: UL System W-L-4011; Hilti CFS-BL Firestop Block.
 - b. 2 Hour Construction: UL System W-L-4060; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - c. 1 Hour Construction: UL System W-L-4011; Hilti CFS-BL Firestop Block.
 - d. 1 Hour Construction: UL System W-L-4060; Hilti FS-ONE MAX Intumescent Firestop Sealant.
6. Insulated Pipes:
- a. 2 Hour Construction: UL System W-L-5028; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - b. 1 Hour Construction: UL System W-L-5028; Hilti FS-ONE MAX Intumescent Firestop Sealant.
7. HVAC Ducts, Insulated:
- a. 2 Hour Construction: UL System W-L-7156; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - b. 1 Hour Construction: UL System W-L-7156; Hilti FS-ONE MAX Intumescent Firestop Sealant.

2.08 FIRESTOPPING SYSTEMS

- A. Firestopping: Any material meeting requirements.
 - 1. Fire Ratings: Use system that is listed by FM (AG), ITS (DIR), or UL (FRD) and tested in accordance with ASTM E814, ASTM E119, or UL 1479 with F Rating equal to fire rating of penetrated assembly and minimum T Rating Equal to F Rating and in compliance with other specified requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify openings are ready to receive the work of this section.

3.02 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.
- B. Remove incompatible materials that could adversely affect bond.
- C. Install damming materials to arrest liquid material leakage.

3.03 INSTALLATION

- A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.
- B. Do not cover installed firestopping until inspected by authorities having jurisdiction.
- C. Install labeling required by code.

3.04 FIELD QUALITY CONTROL

- A. Independent Testing Agency: Inspection agency employed and paid by Owner, will examine penetration firestopping in accordance with ASTM E2174, and ASTM E2393.
- B. Repair or replace penetration firestopping and joints at locations where inspection results indicate firestopping or joints do not meet specified requirements.
- C. Keep areas of work accessible until inspection by applicable Authorities Having Jurisdiction.
- D. Inspection of through-penetration firestopping shall be performed in accordance with ASTM E 2174, "Standard Practice for On-Site Inspection of Installed Fire Stops" or other recognized standard.
- E. Perform under this section patching and repairing of firestopping caused by cutting or penetrating of existing firestop systems already installed by other trades.

- F. Manufacturer's Field Services: During Installation: Provide periodic destructive testing inspections to assure proper installation/application. After installation is complete, submit findings in writing indicating whether or not the installation of the tested system identified was installed correctly.

3.05 CLEANING

- A. Clean adjacent surfaces of firestopping materials.

3.06 PROTECTION

- A. Protect adjacent surfaces from damage by material installation.

END OF SECTION

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**SECTION 07 92 00
JOINT SEALANTS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Nonsag gunnable joint sealants.

1.02 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions: Additional requirements for sealants and primers.
- B. Section 09 21 16 - Gypsum Board Assemblies: Sealing acoustical and sound-rated walls and ceilings.
- C. Section 09 30 00 - Tiling: Sealant between tile and plumbing fixtures and at junctions with other materials and changes in plane.

1.03 REFERENCE STANDARDS

- A. ASTM C794 - Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants 2018 (Reapproved 2022).
- B. ASTM C920 - Standard Specification for Elastomeric Joint Sealants 2018.
- C. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems 2016.
- D. ASTM C1193 - Standard Guide for Use of Joint Sealants 2016.
- E. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants 2022.

1.04 SUBMITTALS

- A. See Section Section 01 33 00 - Shop Drawings, Product Data, and Samples, for submittal procedures.
- B. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, that includes the following.
 - 1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
 - 2. List of backing materials approved for use with the specific product.
 - 3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
 - 4. Substrates the product should not be used on.

- C. Product Data for Accessory Products: Submit manufacturer's technical data sheet for each product to be used, including physical characteristics, installation instructions, and recommended tools.
- D. Preconstruction Laboratory Test Reports: Submit at least four weeks prior to start of installation.

1.05 QUALITY ASSURANCE

- A. Preconstruction Laboratory Testing: Arrange for sealant manufacturer(s) to test each combination of sealant, substrate, backing, and accessories.
 - 1. Adhesion Testing: In accordance with ASTM C794.
 - 2. Compatibility Testing: In accordance with ASTM C1087.
 - 3. Allow sufficient time for testing to avoid delaying the work.
 - 4. Deliver to manufacturer sufficient samples for testing.
 - 5. Report manufacturer's recommended corrective measures, if any, including primers or techniques not indicated in product data submittals.
 - 6. Testing is not required if sealant manufacturer provides data showing previous testing, not older than 24 months, that shows satisfactory adhesion, lack of staining, and compatibility.

1.06 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective work within a five year period after Date of Substantial Completion.
- C. Warranty: Include coverage for installed sealants and accessories that fail to achieve watertight seal , exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS

2.01 JOINT SEALANT APPLICATIONS

- A. Scope:
 - 1. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
 - a. Joints between door, window, and other frames and adjacent construction.
 - b. Other joints indicated below.
 - 2. Do not seal the following types of joints.

- a. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.
 - b. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
 - c. Joints where installation of sealant is specified in another section.
 - d. Joints between suspended panel ceilings/grid and walls.
- B. Interior Joints: Use non-sag polyurethane sealant, unless otherwise indicated.
- 1. Wall and Ceiling Joints in Non-Wet Areas: Acrylic emulsion latex sealant.
 - 2. Wall and Ceiling Joints in Wet Areas: Non-sag polyurethane sealant for continuous liquid immersion.
 - 3. Joints between Fixtures in Wet Areas and Floors, Walls, and Ceilings: Mildew-resistant silicone sealant; white.
- C. Interior Wet Areas: restrooms and showers; fixtures in wet areas include plumbing fixtures, food service equipment, countertops, cabinets, and other similar items.

2.02 JOINT SEALANTS - GENERAL

2.03 NONSAG JOINT SEALANTS

- A. Non-Staining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
- 1. Movement Capability: Plus and minus 50 percent, minimum.
 - 2. Non-Staining To Porous Stone: Non-staining to light-colored natural stone when tested in accordance with ASTM C1248.
 - 3. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
- B. Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single or multi-component; not expected to withstand continuous water immersion or traffic.
- 1. Movement Capability: Plus and minus 25 percent, minimum.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that joints are ready to receive work.
- B. Verify that backing materials are compatible with sealants.

3.02 PREPARATION

- A. Remove loose materials and foreign matter that could impair adhesion of sealant.
- B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
- D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

3.03 INSTALLATION

- A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Perform installation in accordance with ASTM C1193.
- C. Install bond breaker backing tape where backer rod cannot be used.
- D. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.
- E. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.
- F. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

END OF SECTION

SECTION 08 11 13
HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Non-fire-rated hollow metal doors and frames.
- B. Hollow metal frames for wood doors.
- C. Accessories, including glazing and louvers.

1.02 RELATED REQUIREMENTS

- A. Section 08 71 00 - Door Hardware.

1.03 ABBREVIATIONS AND ACRONYMS

- A. ANSI - American National Standards Institute.
- B. ASCE - American Society of Civil Engineers.
- C. HMMA - Hollow Metal Manufacturers Association.
- D. NAAMM - National Association of Architectural Metal Manufacturers.
- E. NFPA - National Fire Protection Association.
- F. SDI - Steel Door Institute.
- G. UL - Underwriters Laboratories.

1.04 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.
- B. ANSI/SDI A250.3 - Test Procedure and Acceptance Criteria for Factory Applied Finish Coatings for Steel Doors and Frames 2007 (R2011).
- C. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors 2011.
- D. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100) 2014.
- E. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames 2011.
- F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2017.

- G. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable 2016.
- H. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength 2017.
- I. BHMA A156.115 - American National Standard for Hardware Preparation in Steel Doors and Steel Frames 2016.
- J. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.
- K. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames 2002.
- L. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames 2011.
- M. NAAMM HMMA 840 - Guide Specifications for Installation and Storage of Hollow Metal Doors and Frames 2007.
- N. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames 2014.
- O. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames 2013.

1.05 SUBMITTALS

- A. See Section Section 01 33 00 - Shop Drawings, Product Data, and Samples, for submittal procedures.
- B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced standards/guidelines.
- C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.
- D. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.
- E. Manufacturer's Certificate: Certification that products meet or exceed specified requirements.
- F. Manufacturer's Qualification Statement.
- G. Installer's Qualification Statement.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than ten years documented experience.

- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.
- C. Maintain at project site copies of reference standards relating to installation of products specified.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
- B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Hollow Metal Doors and Frames:
 - 1. Ceco or Curries, an Assa Abloy Group company: www.assaabloydss.com.
 - 2. Republic Doors, an Allegion brand: www.republicdoor.com/#sle.
 - 3. Door Components, Inc.: www.doorcomponents.com
 - 4. Steelcraft, an Allegion brand: www.allegion.com/#sle.

2.02 DESIGN CRITERIA

- A. Requirements for Hollow Metal Doors and Frames:
 - 1. Steel used for fabrication of doors and frames shall comply with one or more of the following requirements; Galvannealed steel conforming to ASTM A653/A653M, cold-rolled steel conforming to ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel conforming to ASTM A1011/A1011M, Commercial Steel (CS) Type B for each.
 - 2. Accessibility: Comply with ICC A117.1 and ADA Standards.
 - 3. Door Top Closures: Flush end closure channel, with top and door faces aligned.
 - 4. Door Edge Profile: Beveled, both sides.
 - 5. Typical Door Face Sheets: Flush. Refer to Door Schedule for additional information.
 - 6. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings. Style: Flush.
 - 7. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100)

in accordance with specified requirements.

8. Zinc Coating for Typical Interior and/or Exterior Locations: Provide metal components zinc-coated (galvanized) and/or zinc-iron alloy-coated (galvannealed) by the hot-dip process in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness, unless noted otherwise for specific hollow metal doors and frames.
 - a. Based on SDI Standards: Provide at least A40/ZF120 (galvannealed) when necessary, coating not required for typical interior door applications, and at least A60/ZF180 (galvannealed) for corrosive locations.
- B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.03 HOLLOW METAL DOORS

- A. Door Finish: Factory primed and field finished.
- B. Interior Doors, Non-Fire Rated:
 1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 3 - Extra Heavy-duty.
 - b. Physical Performance Level A 1 000 000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Model 2 - Seamless.
 - d. Door Face Metal Thickness: 16 gage, 0.053 inch, minimum.
 - e. Zinc Coating: A60/ZF180 galvannealed coating for wet or corrosive locations; ASTM A653/A653M.
 2. Door Core Material: Manufacturers standard core material/construction and in compliance with requirements.
 3. Door Thickness: 1-3/4 inch, nominal.

2.04 HOLLOW METAL FRAMES

- A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.
- B. Frame Finish: Factory primed and field finished.
- C. Interior Door Frames, Non-Fire Rated: Knock-down type.

1. Frame Metal Thickness: 16 gage, 0.053 inch, minimum.
- D. Frames for Wood Doors: Comply with frame requirements in accordance with corresponding door.
- E. Frames Wider than 48 inches: Reinforce with steel channel fitted tightly into frame head, flush with top.

2.05 FINISHES

- A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.
- B. Factory Finish: Complying with ANSI/SDI A250.3, manufacturer's standard coating.
 1. Color: As indicated on drawings.

2.06 ACCESSORIES

- A. Louvers: Roll formed steel with overlapping frame; finish same as door components; factory-installed.
 1. Fasteners: Concealed fasteners.
- B. Glazing: As specified in Section 08 80 00, factory installed.
- C. Removable Stops: Formed sheet steel, mitered or butted corners; prepared for countersink style tamper proof screws.
- D. Astragals for Double Doors: Specified in Section 08 7100.
- E. Mechanical Fasteners for Concealed Metal-to-Metal Connections: Self-drilling, self-tapping, steel with electroplated zinc finish.
- F. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.
- G. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Verify that finished walls are in plane to ensure proper door alignment.

3.02 INSTALLATION

- A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.
- B. Install prefinished frames after painting and wall finishes are complete.
- C. Coordinate frame anchor placement with wall construction.
- D. Install door hardware as specified in Section 08 71 00.
- E. Coordinate installation of electrical connections to electrical hardware items.
- F. Touch up damaged factory finishes.

3.03 TOLERANCES

- A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117 or NAAMM HMMA 861.
- B. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

3.04 ADJUSTING

- A. Adjust for smooth and balanced door movement.

3.05 SCHEDULE

- A. Refer to Door and Frame Schedule on the drawings.

END OF SECTION

SECTION 08 11 16
ALUMINUM DOORS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Aluminum frames.
- B. Accessories, including louvers, fasteners, and brackets.

1.02 RELATED REQUIREMENTS

- A. Section 08 14 16 - Flush Wood Doors: Wood doors to be installed in aluminum frames specified in this section.
- B. Section 08 71 00 - Door Hardware: Hardware for aluminum doors.

1.03 REFERENCE STANDARDS

- A. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document) 2015.
- B. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum 2020.
- C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.
- D. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2014.
- E. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric) 2014.
- F. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes 2021.
- G. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric) 2021.

1.04 SUBMITTALS

- A. See Section 01 33 00 - Shop Drawings, Product Data, and Samples, for submittal procedures.
- B. Product Data: Manufacturer's descriptive literature for each type of door; include information on fabrication methods.
- C. Shop Drawings: Include elevations of each opening type.
- D. Verification Samples: Actual pieces of products in each finish specified, not less than 6 inches square or 6 inches long for linear components. For finishes subject to color

variation, include not less than two samples illustrating extreme range to be anticipated.

PART 2 PRODUCTS

2.01 DOORS AND FRAMES

- A. Aluminum Frames for Doors, Sidelights, or Transoms: Extruded aluminum, non-thermally broken hollow or C-shaped sections; no steel components.
 - 1. Finish: Class I - Natural anodized.
- B. Dimensions and Shapes: As indicated on drawings; dimensions indicated are nominal.
 - 1. Provide the following clearances:
 - a. Hinge and Lock Stiles: 1/8 inch.
 - b. Between Meeting Stiles: 1/4 inch.
 - c. At Top Rail and Bottom Rail: 1/8 inch.

2.02 COMPONENTS

- A. Frames: Extruded aluminum shapes, not less than 0.062 inch thick, reinforced at hinge and strike locations.
 - 1. Corner Brackets: Extruded aluminum, fastened with stainless steel screws.
 - 2. Trim: Extruded aluminum, not less than 0.062 inch thick, removable snap-in type without exposed fasteners.

2.03 MATERIALS

- A. Aluminum Sheet: ASTM B209 (ASTM B209M), alloy 5005, temper H14, stretcher leveled.
- B. Extruded Aluminum: ASTM B221 (ASTM B221M), alloy 6063, temper T5, or alloy 6463, temper T5.

2.04 FINISHES

- A. Class I Natural Anodized Finish: Clear anodic coating; AAMA 611 AA-M12C22A41, minimum dry film thickness (DFT) of 0.7 mils, 0.0007 inch.

2.05 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M), alloy 6063-T5 or alloy 6463-T5.

2.06 COMPONENTS

- A. Aluminum Door Frames: Provide frames sized to fit wall thicknesses indicated on the drawings, in profiles indicated, and constructed from materials as follows:

1. Frame Members: Extruded aluminum shapes, not less than 0.062 inch thick, reinforced at hinge and strike locations.
2. Replaceable Weatherstripping: AAMA 701/702 wool pile.
3. Glazing: As specified in Section 08 8000 - Glazing.

2.07 FINISHES

- A. Finish: Clear anodic coating; AAMA 611 AA-M12C22A31 Class II, minimum thickness 0.4 mil.

2.08 FABRICATION

- A. Door sizes shown are nominal; provide standard clearances as follows:
 1. Hinge and Lock Stiles: 0.125 inch.
 2. Between Meeting Stiles: 0.250 inch.
 3. At Top Rail and Bottom Rail: 0.125 inch.

2.09 ACCESSORIES

- A. Fasteners: Aluminum, non-magnetic stainless steel, or other material warranted by manufacturer as non-corrosive and compatible with aluminum components.
- B. Brackets and Reinforcements: Manufacturer's high-strength aluminum units where feasible, otherwise, non-magnetic stainless steel or steel hot-dip galvanized in compliance with ASTM A123/A123M.
- C. Bituminous Coating: Cold-applied asphaltic mastic, compounded for 30-mil thickness per coat.

PART 3 EXECUTION

3.01 PREPARATION

- A. Perform cutting, fitting, forming, drilling, and grinding of frames as required for project conditions.
- B. Replace components with damage to exposed finishes.
- C. Separate dissimilar metals to prevent electrolytic action between metals.

3.02 INSTALLATION

- A. Install doors and frames in accordance with manufacturer's instructions and approved shop drawings.
- B. Set frames plumb, square, level, and aligned to receive doors. Anchor frames to adjacent construction in strict accordance with manufacturer's recommendations and

within specified tolerances.

- C. Where aluminum surfaces contact metals other than stainless steel, zinc, or small areas of white bronze, protect from direct contact by painting dissimilar metal with heavy coating of bituminous paint.
- D. Hang doors and adjust hardware to achieve specified clearances and proper door operation.

3.03 CLEANING

- A. Upon completion of installation, thoroughly clean door and frame surfaces in accordance with AAMA 609 & 610.
- B. Do not use abrasive, caustic, or acid cleaning agents.

3.04 PROTECTION

- A. Protect products of this section from damage caused by subsequent construction until Date of Substantial Completion.
- B. Replace damaged or defective components that cannot be repaired to a condition indistinguishable from undamaged components.

END OF SECTION

SECTION 08 14 16
FLUSH WOOD DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Flush wood doors; flush and flush glazed configuration; fire-rated, non-rated, and acoustical with wood veneer or High Pressure Decorative Laminate (HPDL) finish as indicated on the drawings.

1.02 RELATED REQUIREMENTS

- A. Section 08 11 13 - Hollow Metal Doors and Frames.
- B. Section 08 71 00 - Door Hardware.
- C. Section 09 90 00 - Painting and Coating: Field finishing of doors.

1.03 REFERENCE STANDARDS

- A. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements 2009 (Reapproved 2016).
- B. ASTM E413 - Classification for Rating Sound Insulation 2016.
- C. ASTM E1408 - Standard Test Method for Laboratory Measurement of the Sound Transmission Loss of Door Panels and Door Systems; 1991 (Reapproved 2000).
- D. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards 2021, with Errata.
- E. NEMA LD 3 - High-Pressure Decorative Laminates 2005.
- F. NFPA 80 - Standard for Fire Doors and Other Opening Protectives 2016.
- G. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives 2016.
- H. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies Current Edition, Including All Revisions.
- I. UL 1784 - Standard for Air Leakage Tests of Door Assemblies Current Edition, Including All Revisions.
- J. WI (CCP) - Certified Compliance Program (CCP) Current Edition.

1.04 SUBMITTALS

- A. See Section 01 33 00 - Shop Drawings, Product Data, and Samples, for submittal procedures.

- B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.
- C. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.
 - 1. Provide information as required by AWMAC/WI (NAAWS).
 - 2. Include certification program label.
- D. Samples: Submit two samples of door veneer, 4 by 4 inch in size illustrating wood grain, stain color, and sheen and/or plastic laminate pattern and color.
- E. Certificate: Submit labels and certificates required by quality assurance and quality control programs.
- F. Test Reports: Show compliance with specified requirements for the following:
 - 1. Sound-retardant doors and frames; sealed panel tests are not acceptable.
- G. Warranty, executed in Owner's name.

1.05 QUALITY ASSURANCE

- A. Quality Certification:
 - 1. Comply with {rs\#1} woodwork association quality certification service/program in accordance with requirements for work specified in this section:
www.woodworkinstitute.com/#sle.
 - 2. Provide labels or certificates indicating that the installed work complies with AWMAC/WI (NAAWS) requirements for grade or grades specified.
 - 3. Provide designated labels on shop drawings as required by certification program.
 - 4. Provide designated labels on installed products as required by certification program.
 - 5. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Package, deliver and store doors in accordance with specified quality standard.
- B. Accept doors on site in manufacturer's packaging. Inspect for damage.
- C. Protect doors with resilient packaging sealed with heat shrunk plastic. Do not store in damp or wet areas; or in areas where sunlight might bleach veneer. Seal top and bottom edges with tinted sealer if stored more than one week. Break seal on site to permit ventilation.

1.07 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Interior Doors: Provide manufacturer's warranty for the life of the installation.
- C. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 PRODUCTS

2.01 DOORS AND PANELS

- A. Doors: Refer to drawings for locations and additional requirements.
 - 1. Quality Standard: Premium Grade, Heavy Duty performance, in accordance with AWMAC/WI (NAAWS), unless noted otherwise.
 - 2. Wood Veneer Faced Doors: 5-ply unless otherwise indicated.
 - 3. High Pressure Decorative Laminate (HPDL) Faced Doors: 5-ply unless otherwise indicated.
- B. Interior Doors: 1-3/4 inches thick unless otherwise indicated; flush construction.
 - 1. Provide solid core doors at each location.
 - 2. Fire Rated Doors: Tested to ratings indicated on drawings in accordance with UL 10C - Positive Pressure; Underwriters Laboratories Inc (UL) or Intertek/Warnock Hersey (WHI) labeled without any visible seals when door is open.
 - 3. Smoke and Draft Control Doors (Indicated as "S" on Drawings): In addition to required fire rating, provide door assemblies tested in accordance with UL 1784 with maximum air leakage of 3.0 cfm per sq ft of door opening at 0.10 inch wg pressure at both ambient and elevated temperatures for "S" label; if necessary, provide additional gasketing or edge sealing.
 - 4. Sound-Rated Doors: Minimum STC as indicated on drawings, calculated in accordance with ASTM E413, tested in accordance with ASTM E90.
 - 5. Wood veneer facing with factory transparent finish as indicated on drawings.
 - 6. High pressure decorative laminate (HPDL) finish as indicated on drawings.

2.02 DOOR AND PANEL CORES

- A. Non-Rated Solid Core and 20 Minute Rated Doors: Type structural composite lumber core (SCLC), plies and faces as indicated.
- B. Fire-Rated Doors: Mineral core type, with fire resistant composite core (FD), plies and faces as indicated above; with core blocking as required to provide adequate anchorage of hardware without through-bolting.

- C. Sound-Rated Doors: Equivalent to type, with particleboard core (PC) construction as required to achieve STC rating specified; plies and faces as indicated above.

2.03 DOOR FACINGS

- A. Veneer Facing for Transparent Finish: as indicated on the drawings, veneer grade in accordance with quality standard indicated, plain sliced (flat cut), with book match between leaves of veneer, running match of spliced veneer leaves assembled on door or panel face.
- B. High Pressure Decorative Laminate (HPDL) Facing for Fire Doors: NEMA LD 3, SGF; color(s) as indicated; textured, low gloss finish.
- C. High Pressure Decorative Laminate (HPDL) Facing for Non-Fire-Rated Doors: NEMA LD 3, HGS; color(s) as indicated; textured, low gloss finish.
- D. Facing Adhesive: Type I - waterproof.

2.04 DOOR CONSTRUCTION

- A. Fabricate doors in accordance with door quality standard specified.
- B. Cores Constructed with stiles and rails:
- C. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.
- D. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.
- E. Provide edge clearances in accordance with the quality standard specified.

2.05 ACCESSORIES

- A. Astragals for Non-Rated Double Doors: Steel, T shaped, overlapping and recessed at face edge.
- B. Astragals for Fire-Rated Double Doors: Steel, T shaped, overlapping and recessed at face edge, specifically for double doors.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install doors in accordance with manufacturer's instructions and specified quality standard.
 - 1. Install fire-rated doors in accordance with NFPA 80 requirements.
 - 2. Install smoke and draft control doors in accordance with NFPA 105 requirements.

- B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.
- C. Use machine tools to cut or drill for hardware.
- D. Coordinate installation of doors with installation of frames and hardware.

3.02 TOLERANCES

- A. Conform to specified quality standard for fit and clearance tolerances.
- B. Conform to specified quality standard for telegraphing, warp, and squareness.

3.03 ADJUSTING

- A. Adjust doors for smooth and balanced door movement.
- B. Adjust closers for full closure.

3.04 SCHEDULE - SEE DRAWINGS

END OF SECTION

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SECTION 08 31 00
ACCESS DOORS AND PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wall and ceiling access door and frame units.

1.02 RELATED REQUIREMENTS

- A. Section 02 41 00 - Demolition: access panels for utilities beyond the project area.

1.03 REFERENCE STANDARDS

- A. ITS (DIR) - Directory of Listed Products Current Edition.
- B. UL (FRD) - Fire Resistance Directory Current Edition.

1.04 PRICE AND PAYMENT PROCEDURES

- A. Unit Prices: See Section 01 22 00 - Unit Prices.
 - 1. General: Access panels shown on the drawings are include in the base bid. Unit Prices only apply to additional access panels as necessary. To the extent possible coordinate above utility access with existing panels and access panels shown on the drawings. Minimize number of additional access panels.
 - 2. Submit unit prices per unit, installed cost, for each type of access panel necessary. At a minimum, provide unit pricing for the following
 - a. 18" x 18" non-fire-rated units
 - b. 18" x 18" fire-rated units
 - c. 12" x 12" non-fire rated units
 - d. 12" x 12" fire-rated units
 - e. Other types as necessary
 - 3. Payment Procedures:
 - a. The Owner provides payment based on actual quantities and measurements that are applied and verified by the Architect.
 - b. The Owner does not provide additional compensation for extraneous, non-conforming, or rejected work.

1.05 SUBMITTALS

- A. See Section 01 33 00 - Shop Drawings, Product Data, and Samples, for submittal procedures.
- B. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.
- C. Shop Drawings: Indicate exact position of each access door and/or panel unit.
 - 1. Include access panels shown on the drawings and additional access panels as required for access to concealed valves, cleanouts, devices and similar.
 - 2. Coordinate with the Utility Access Plan submittal in section 02 41 00 - Demolition for additional access panels beyond the project area.
 - 3. Coordinate access panel location with above ceiling utilities to provide unobstructed access through the panel.
 - 4. Refer to Ceiling General Notes on sheet A-000 for ceiling layout rules governing the locations of access panels.
 - 5. Indicate fire-rate units with required hourly rating and product listing by ITS (DIR) or UL (FRD).

PART 2 PRODUCTS

2.01 WALL AND CEILING MOUNTED UNITS

- A. Manufacturers:
 - 1. Activar Construction Products Group - JL Industries: www.activarcpg.com/#sle.
 - 2. ACUDOR Products Inc: www.acudor.com/#sle.
 - 3. Babcock-Davis: www.babcockdavis.com/#sle.
 - 4. Cendrex, Inc: www.cendrex.com/#sle.
 - 5. Karp Associates, Inc: www.karpinc.com/#sle.
 - 6. Milcor, Inc: www.milcorinc.com/#sle.
 - 7. Nystrom, Inc: www.nystrom.com/#sle.
- B. Wall and Ceiling Mounted Units: Factory fabricated door and frame, fully assembled units with corner joints welded, filled and ground flush; square and without rack or warp; coordinate requirements with type of installation assembly being used for each unit.
 - 1. Material: Steel.

2. Style: Exposed frame with door surface flush with frame surface.
 - a. Gypsum Board Mounting Criteria: Use drywall bead type frame.
 - b. Plaster Mounting Criteria: Use plaster bead type frame.
3. Door Style: Single thickness with rolled or turned in edges.
4. Frames: 16 gage, 0.0598 inch, minimum thickness.
5. Frames and flanges: 0.058 inch steel.
6. Door panels: 0.070 inch single thickness steel sheet.
7. Units in Fire-Rated Assemblies: Fire rating as required by applicable code for fire-rated assembly that access doors are being installed.
 - a. Provide products listed by ITS (DIR) or UL (FRD) as suitable for purpose indicated.
8. Steel Finish: Primed.
9. Primed and Factory Finish: Polyester powder coat; field paint to match ceiling or wall paint color; do not paint hardware..
10. Door/Panel Size: 18" x 18", typical. For locations only requiring tool access provide 12" x 12"..
11. Hardware:
 - a. Hardware for Fire-Rated Units: As required for listing.
 - b. Hinges for Non-Fire-Rated Units: Concealed, constant force closure spring type.
 - c. Hinge: Non-Fire-Rated Units: 175 degree steel hinges with removable pin.
 - d. Latch/Lock: Screw driver slot for quarter turn cam latch.
12. Finish: No. 4 finish.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that rough openings are correctly sized and located.
- B. Begin installation only after substrates have been properly prepared, and if the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to proceeding with this work.
- B. Prepare surfaces using methods recommended by manufacturer for applicable substrates in accordance with project conditions.

3.03 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.
- B. Install frames plumb and level in openings, and secure units rigidly in place.
- C. Position units to provide convenient access to concealed equipment when necessary.

END OF SECTION

SECTION 08 32 50
MULTI-PANEL SLIDING DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Factory fabricated sliding doors panels and operating hardware.

1.02 RELATED REQUIREMENTS

- A. Section 08 71 00 - Door Hardware

1.03 SUBMITTALS

- A. See Section 01 33 00 - Shop Drawings, Product Data, and Samples, for submittal procedures.
- B. Shop Drawings: Indicate opening dimensions, elevations of different types, and framed opening tolerances.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of type specified in this section, with at least three years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to project site and store in manufacturer's protective cartons until openings are ready for door installation.
- B. Protect finished surfaces with wrapping paper or strippable coating during installation. Do not use adhesive papers or sprayed coatings that bond to substrate when exposed to sunlight or weather.

1.06 FIELD CONDITIONS

- A. Do not install sealants when ambient temperature is less than 40 degrees F.
- B. Maintain this minimum temperature during and 24 hours after installation of sealants.

1.07 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Sliding Doors:

1. Raydoor Sliding Walls and Doors: <https://www.raydoor.com/systems/sliding/wall>
2. The Sliding Door Company: <https://www.slidingdoorco.com/suspended-doors>
3. Or equal.

2.02 SLIDING DOORS

- A. Overhead Track Multi-panel Telescoping Doors: Operable panel frame and insert, factory fabricated; complete with integral telescoping overhead hardware. No bottom track.
1. Configuration: Sliding wall, 3 panels
 2. Frame Finish: Plastic Laminate
 3. Frame Color: Brushed Steel
 4. Insert Finish: Acrylic
 5. Insert Color: Opal
 6. Patterns: None
 7. Pull Handles: Recessed Rectangular Pull, brushed metal

PART 3 EXECUTION

3.01 EXAMINATION

3.02 INSTALLATION

- A. Install sliding door units in accordance with manufacturer's instructions.
- B. Use anchorage devices to securely fasten sliding door assembly to header construction without distortion or imposed stresses.

3.03 ADJUSTING

- A. Adjust hardware for smooth operation.

3.04 CLEANING

- A. Wash surfaces by method recommended and acceptable to sealant and sliding door manufacturer; rinse and wipe surfaces clean.

- B. Remove excess sealant by moderate use of mineral spirits or other solvent acceptable to sealant manufacturer.

3.05 PROTECTION

- A. Protect installed products from damage during subsequent construction activities.

END OF SECTION

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SECTION 08 71 00
DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes items known commercially as door or finish hardware that are required for swing, sliding, and folding doors, except special types of unique hardware specified in the same sections as the doors and door frames on which they are installed.
- B. Related Sections: The following sections are noted as containing requirements that relate to this Section, but may not be limited to this listing.
 - 1. Division 08: Section - Hollow Metal Doors and Frames.
 - 2. Division 08: Section - Wood Doors.

1.3 REFERENCES

- A. 2019 California Building Code, CCR Title 24, Part 2
- B. BHMA - Builders' Hardware Manufacturers Association
- C. DHI - Door and Hardware Institute
- D. NFPA - National Fire Protection Association.
 - 1. NFPA 80 - Fire Doors and Other Opening Protectives
 - 2. NFPA 105 - Smoke and Draft Control Door Assemblies
- E. UL - Underwriters Laboratories.
 - 1. UL 10C - Fire Tests of Door Assemblies
 - 2. UL 305 - Panic Hardware
- F. WHI - Warnock Hersey Incorporated
- G. SDI - Steel Door Institute

1.4 SUBMITTALS & SUBSTITUTIONS

- A. General: Submit in accordance with Conditions of the Contract and Division 01 Specification sections.
- B. Submit product data (catalog cuts) including manufacturers' technical product information for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
- C. Submit electronic PDF copies of schedule organized vertically into "Hardware Sets" with index of doors and headings, indicating complete designations of every item required for each door or opening. Include following information:
 - 1. Include a Cover Sheet with:
 - a. Job Name, location, telephone number.
 - b. Architects name, location and telephone number.
 - c. Contractors name, location, telephone number and job number.
 - d. Suppliers name, location, telephone number and job number.
 - e. Hardware consultant's name, location and telephone number.
 - 2. Job Index information included:
 - a. Numerical door number index including; door number, hardware heading number and page number.
 - b. Complete keying information (referred to DHI hand-book "Keying Systems and Nomenclature"). Provision should be made in the schedule to provide keying

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information when available; if it is not available at the time the preliminary schedule is submitted.

- c. Manufacturers' names and abbreviations for all materials.
- d. Explanation of abbreviations, symbols, and codes used in the schedule.
- e. Mounting locations for hardware.
- f. Clarification statements or questions.
- g. Catalog cuts and manufacturer's technical data and instructions.

3. Vertical schedule format sample:

Heading Number 1 (Hardware group or set number - HW Group #1)				
(a) 1 Single - Door #101 - Corridor 101 to Exterior			(b) 90°	(c) RH
(d) 3'-0" x 7'-0" x 1-3/4" - Wood Door x Hollow Metal Frame - 20 Minute				
(e) 1.	(f) 3 ea	(g) Hinges - (h) 5BB1 4.5 x 4.5 NRP	(i) 1/2 TMS	(j) 630
2.	1 ea	Lockset - ND80P6D x RHO x RH x 10-025 x JTMS		(k) IVE
3.	1 ea	Closer - 4040XP x EDA x TBSRT	626	SCH
			689	LCN

- (a) Single or pair of doors with opening number and location.
- (b) Degree of opening.
- (c) Hand of door(s).
- (d) Door/frame dimensions and material; Label requirements, if any.
- (e) Hardware item line # (Optional).
- (f) Quantity.
- (g) Product description.
- (h) Product part number.
- (i) Fastenings and other pertinent information.
- (j) Hardware finish codes per ANSI/BHMA A156.18.
- (k) Manufacturer abbreviation.

- D. Make substitution requests in accordance with Division 01. Substitution requests must be made prior to bid date. Include product data and indicate benefit to the project. Furnish samples of any proposed substitution.
- E. Wiring Diagrams: Provide product data and wiring and riser diagrams for all electrical products listed in the Hardware Schedule portion of this section.
- F. Keying Schedule: Submit separate detailed schedule indicating clearly how the Owner's final instructions on keying of locks has been fulfilled.
- G. Templates for doors, frames, and other work specified to be factory prepared for the installation of door hardware. Check shop drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- H. Furnish as-built/as-installed schedule with close-out documents, including keying schedule and transcript, wiring/riser diagrams, manufacturers' installation and adjustment and maintenance information.
- I. Fire Door Assembly Testing: Submit a written record of each fire door assembly to the Owner to be made available to the Authority Having Jurisdiction (AHJ) for future building inspections.

1.5 QUALITY ASSURANCE

- A. Obtain each type of hardware (latch and lock sets, hinges, closers, exit devices, etc.) from a single manufacturer.
- B. Supplier Qualifications: A recognized architectural door hardware supplier, with warehousing facilities in the project's vicinity, that has a record of successful in-service performance for

supplying door hardware similar in quantity, type, and quality to that indicated for this project and that employs an experienced architectural hardware consultant (AHC) who is available to Owner, Architect, and Contractor, at reasonable times during the course of the Work, for consultation.

1. Responsible for detailing, scheduling and ordering of finish hardware.
 2. Meet with Owner to finalize keying requirements and to obtain final instructions in writing.
 3. Stock parts for products supplied and are capable of repairing and replacing hardware items found defective within warranty periods.
- C. Hardware Installer: Company specializing in the installation of commercial door hardware with five years documented experience.
- D. Fire-Rated Openings: Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction. Provide only items of door hardware that are listed and tested by UL or Warnock Hersey for given type/size opening and degree of label. Provide proper latching hardware, door closers, approved-bearing hinges and seals whether listed in the Hardware Schedule or not.
1. Where emergency exit devices are required on fire-rated doors, (with supplementary marking on doors' UL labels indicating "Fire Door to be Equipped with Fire Exit Hardware") provide UL label on exit devices indicating "Fire Exit Hardware".
- E. Exit Doors: Operable from inside with single motion without the use of a key or special knowledge or effort.
- F. Product packaging to be labelled in compliance with CA Prop 65, Safe Drinking Water and Toxic Enforcement Act of 1986.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Coordinate delivery of packaged hardware items to the appropriate locations (shop or field) for installation.
- B. Hardware items shall be individually packaged in manufacturers' original containers, complete with proper fasteners. Clearly mark packages on outside to indicate contents and locations in hardware schedule and in work.
- C. Provide locked storage area for hardware, protect from moisture, sunlight, paint, chemicals, etc.
- D. Contractor to inventory door hardware jointly with representatives of hardware supplier and hardware installer until each all are satisfied that count is correct.

1.7 WARRANTY

- A. Provide warranties of respective manufacturers' regular terms of sale from day of final acceptance as follows:
1. Locksets: Three (3) years.
 2. Closers: Thirty (30) years.
 3. Electronic: One (1) year.
 4. All other hardware: Two (2) years.

1.8 MAINTENANCE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

1.9 PRE-INSTALLATION CONFERENCE

- A. Convene a pre-installation conference at least one week prior to beginning work of this section.
- B. Attendance: Architect, Construction Manager, Contractor, Security Contractor, Hardware Supplier, Installer, Key Owner's Personnel, and Project Inspector.
- C. Agenda: Review hardware schedule, products, installation procedures and coordination required with related work. Review Owner's keying standards.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

Item	Manufacturer	Acceptable Substitutes
Hinges	Ives	Hager, Stanley, McKinney
Locks, Latches & Cylinders	Schlage	None – Owner Standard
Closers	LCN	None – Owner Standard
Push, Pulls & Protection Plates	Ives	Trimco, BBW, DCI
Flush Bolts	Ives	Trimco, BBW, DCI
Coordinators	Ives	Trimco, BBW, DCI
Door Stops	Ives	Trimco, BBW, DCI
Overhead Stops	Glynn-Johnson	Or Approved Equal
Seals & Thresholds	Zero	Pemko, National Guard

2.2 MATERIALS

- A. Hinges:
- Provide hinges conforming to ANSI/BHMA A156.1.
 - Hinges shall be sized in accordance with the following:
 - Height:
 - Doors up to 42" wide: 4-1/2 inches.
 - Doors 43" to 48" wide: 5 inches.
 - Width: Sufficient to clear frame and trim when door swings 180 degrees.
 - Number of Hinges: Provide 3 hinges per leaf to 7'-5" in height. Add one for each additional 2 feet in height.
 - Exterior out-swinging hinges shall be non-ferrous material and shall have stainless steel hinge pins. All doors to have non-rising pins.
 - Furnish non-removable pins (NRP) at all exterior out-swing doors and interior key lock doors with reverse bevels.
 - Provide hinges with electrified options as scheduled in the hardware sets. Provide with sufficient number and wire gage to accommodate electric function of specified hardware. Locate electric hinge at second hinge from bottom or nearest to electrified locking component.
- B. Continuous Hinges:
- Provide aluminum geared continuous hinges fabricated from 6063-T6 aluminum conforming to ANSI/BHMA A156.26, Grade 1.
 - Provide split nylon bearings at each hinge knuckle for quiet, smooth, self-lubricating operation.
 - Provide continuous hinges capable of supporting door weights up to 450 pounds, and successfully tested for 1,500,000 cycles.
 - Provide continuous hinges 1" shorter in length than nominal height of door, unless otherwise noted, with symmetrical hole pattern.
 - On fire-rated doors, provide continuous hinges that are UL listed for use on fire-rated doors.
 - Install continuous hinges with fasteners supplied by manufacturer.
- C. Heavy Duty Mortise Locks and Latches: Schlage "L" Series as scheduled with "06" style lever and "A" style rose.
- Provide mortise locks conforming to ANSI/BHMA A156.13 Series 1000, Grade 1, and UL Listed for 3 hour fire doors.
 - Provide locks manufactured from heavy gauge steel, containing components of steel with a zinc dichromate plating for corrosion resistance.
 - Provide lock case that is multi-function and field reversible for handing without opening case.

4. Provide locks with standard 2-3/4" backset with full 3/4" throw stainless steel mechanical anti-friction latchbolt. Provide deadbolt with full 1" throw, constructed of stainless steel.
 5. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
 6. Cylinders: Refer to "KEYING" article, herein.
 7. Indicators: Where specified, provide indicator above cylinder or emergency release for visibility while operating the lock that identifies an occupied/unoccupied status of the lock or latch.
 8. Lever Trim: Solid brass, bronze, or stainless steel, cast or forged in design specified, with wrought roses and external lever spring cages. Provide thru-bolted levers with 2-piece spindles.
 9. Provide electrified options as scheduled in the hardware sets. Where scheduled, provide switches and sensors integrated into the locks and latches.
 - a. 12 or 24 volt DC auto-detecting operating capability.
 - b. Selectable EL (fail safe) or EU (fail secure) operating mode via switch on chassis.
 - c. 0.23A (230mA) maximum current draw.
 - d. 0.01A (10mA) holding current.
 - e. Modular request to exit (RX) switch.
- D. Closers: LCN as scheduled.
1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. ISO 9000 certify closers. Stamp units with date of manufacture code.
 2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.
 3. Provide certificate by independent testing laboratory that door closers have completed over 10,000,000 cycles and can still meet ANSI/BHMA A156.4 standards.
 4. Cylinder Body: 1-1/2" diameter with 3/4" diameter double heat-treated pinion journal.
 5. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120° F to -30° F.
 6. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.
 7. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck.
 8. Provide closers with solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers.
 9. Pressure Relief Valve (PRV) Technology: Not permitted.
 10. Provide door closers powder coated to match balance of door hardware. Powder coating finish shall be certified to exceed 100 hours salt spray testing as described in ANSI/BHMA A156.4 and ASTM B117.
 11. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.
- E. Flush Bolts & Dust Proof Strikes:
1. Automatic flush bolts shall be of the low operating force design.
 2. Provide top bolt only model for interior doors where applicable and as permitted by testing procedures.
 3. Provide dust proof strikes at openings using bottom bolts.
 4. Manual flush bolts shall only be permitted on storage or mechanical openings, as scheduled.
- F. Door Stops:
1. Unless otherwise noted in hardware sets, provide wall type with appropriate fasteners. Where wall type cannot be used, provide floor type. If neither can be used, provide overhead type.

2. Do not install floor stops more than four (4) inches from the face of the wall or partition (CBC Section 11B-307).
 3. Provide backing plate at wall framing behind wall type.
 4. Overhead stops shall be made of stainless steel and non-plastic mechanisms and finished metal end caps. Field-changeable hold-open, friction and stop-only functions. Stop-only function shall be provided at fire-rated openings.
- G. Protection Plates:
1. Provide kick, mop, and/or armor plates minimum of 0.050" thick, with four beveled edges. Furnish with sheet metal or wood screws, finished to match plates.
 2. Kick plates shall be sized 10" high and 2" less door width (LDW) at single doors and 10" high and 1" LDW at pairs or doors.
 3. Provide mop and armor plates with sizes as scheduled in hardware sets.
- H. Thresholds: As scheduled and per details.
1. Thresholds shall not exceed 1/2" in height, with a beveled surface of 1:2 maximum slope. Thresholds shall comply with CBC Section 11B-404.2.5.
 2. Set thresholds in a full bed of butyl-rubber or polyisobutylene mastic sealant complying with requirements in Division 07 "Thermal and Moisture Protection".
 3. Use 1/4" fasteners, red-head flat-head sleeve anchors (SS/FHSL).
- I. Seals: Provide silicone gasket at all rated and exterior doors.
1. Smoke & Draft Control Doors: Provide UL10C Classified gasketing that complies with NFPA 80 & NFPA 252 for use on "S" labeled Positive Pressure door assemblies.

2.3 KEYING

- A. Furnish a Proprietary Schlage masterkey system as directed by the owner or architect. Key system to be designated and combined by the Schlage Master Key Department even if pinned by the Authorized Key Center, Authorized Security Center or a local authorized commercial dealer.
- B. A detailed keying schedule is to be prepared by the owner and/or architect in consultation with a representative of Allegion or an Authorized Key Center or Authorized Security Center. Each keyed cylinder on every keyed lock is to be listed separately showing the door #, key group (in BHMA terminology), cylinder type, finish and location on the door.
- C. Furnish all cylinders in the Schlage Full Size Interchangeable Core (FSIC) format. Pack change keys independently (PKI).
- D. Furnish construction keying for doors requiring locking during construction.
- E. Furnish all keys with visual key control.
1. Stamp key "Do Not Duplicate".
 2. Stamp (BHMA) key symbol on key.
 3. Stamp unique owner identifier from the key bow.
- F. Furnish mechanical keys as follows:
1. Furnish 2 cut change keys for each different change key code.
 2. Furnish 1 uncut key blank for each change key code.
 3. Furnish 6 cut masterkeys for each different masterkey set.
 4. Furnish 3 uncut key blanks for each masterkey set.
 5. Furnish 2 cut control keys cut to the top masterkey for permanent I/C cylinders.
 6. Furnish 1 cut control key cut to each SKD combination.

2.4 FINISHES

- A. Generally to be satin chrome US26D (626 on bronze and 652 on steel) unless otherwise noted.
- B. Furnish push plates, pull plates and kick or armor plates in satin stainless steel US32D (630) unless otherwise noted.

- C. Door closers shall be powder-coated to match other hardware, unless otherwise noted.
- D. Aluminum items to be finished anodized aluminum except thresholds which can be furnished as standard mill finish.

2.5 FASTENERS

- A. Screws for strikes, face plates and similar items shall be flat head, countersunk type, provide machine screws for metal and standard wood screws for wood.
- B. Screws for butt hinges shall be flathead, countersunk, full-thread type.
- C. Fastening of closer bases or closer shoes to doors shall be by means of sex bolts and spray painted to match closer finish.
- D. Provide expansion anchors for attaching hardware items to concrete or masonry.
- E. All exposed fasteners shall have a phillips head.
- F. Finish of exposed screws to match surface finish of hardware or other adjacent work.
- G. All Exit Devices and Lock Protectors shall be fastened to the door by the means of sex bolts or through bolts.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Verify that doors and frames are square and plumb and ready to receive work and dimensions are as instructed by the manufacturer.
- B. Beginning of installation means acceptance of existing conditions.
- C. Fire-Rated Door Assembly Inspection: Upon completion of the installation, all fire door assemblies shall be inspected to confirm proper operation of the closing device and latching device and that only the manufacturer's furnished fasteners are used for installation and that it meets all criteria of a fire door assembly per NFPA 80 (Standard for Fire Doors and Other Opening Protectives) 2016 Edition. A written record shall be maintained and transmitted to the Owner to be made available to the Authority Having Jurisdiction (AHJ). The inspection of the swinging fire doors shall be performed by a certified FDAI (Fire Door Assembly Inspector) with knowledge and understanding of the operating components of the type of door being subjected to the inspection. The record shall list each fire door assembly throughout the project and include each door number, an itemized list of hardware set components at each door opening, and each door location in the facility.

3.2 INSTALLATION

- A. Install hardware in accordance with manufacturer's instructions and requirements of DHI.
- B. Use the templates provided by hardware item manufacturer.
- C. Mounting heights for hardware shall be as recommended by DHI. Operating hardware shall be located between 34" and 44" above finish floor to comply with CBC Section 11B-404.2.7.
- D. Door Closers:
 - 1. Place door closers inside building, stairs, rooms, etc. Closers shall be installed to permit doors to swing 180 degrees or maximum allowable by conditions.
 - 2. Maximum effort to operate closers shall not exceed 5 lbs., such pull or push effort being applied at right angles to hinged doors.
 - 3. When fire doors are required, the maximum effort to operate the closer may be increased but shall not exceed 15 lbs. when specifically approved by fire marshal.
 - 4. All closers shall be adjusted to operate with the minimum amount of opening force and still close and latch the door. These forces do not apply to the force required to retract latch bolts or disengage other devices that hold the door in a closed position.
 - 5. Compensating devices or automatic door operators may be utilized to meet the above standards.

6. Per CBC Section 11B-404.2.8.1, doors shall take minimum of 5 seconds to move from an open position of 90 degrees to 12 degrees to the latch jamb.
- E. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.
- F. Drill and countersink units that are not factory-prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.
- G. Set thresholds for exterior doors in full bed of butyl-rubber sealant.
- H. If hand of door is changed during construction, make necessary changes in hardware at no additional cost.
- I. Electronic Hardware:
 1. Hardware Installer shall coordinate with security contractor to route cable to connect electrified locks, panic hardware and fire exit hardware to power transfers or electric hinges at the time these items are installed so as to avoid disassembly and reinstallation of hardware.
 2. Hardware Installer shall also be present with the security contractor when the power is turned on for the testing of the electronic hardware applications. Installer shall make adjustments to solenoids, latches, vertical rods and closers to insure proper and secure operation.
 3. All wiring for electro-mechanical hardware mounted on the door shall be connected through the power transfer and terminated in the interface junction box specified for in the Electrical Section.
 4. Conductors shall be minimum 18 gage stranded, multicolored. A minimum 12 in. loop of conductors shall be coiled in the interface junction box. Each conductor shall be permanently marked with its function.
 5. If a power supply is specified in the hardware sets, all conductors shall be terminated in the power supply. Make all connections required for proper operation between the power supply and the electro-mechanical hardware. Provide the proper size conductors as specified in the manufacturer's technical documentation.

3.3 ADJUST AND CLEAN

- A. Adjust and check each operating item of hardware and each door, to ensure proper operation or function of every unit. Replace units which cannot be adjusted to operate freely and smoothly as intended for the application made.
- B. Clean adjacent surface soiled by hardware installation.
- C. Final Adjustment: Wherever hardware installation is made more than one month prior to acceptance or occupancy, return to that work area and make final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.
- D. Instruct Owner's Personnel in proper adjustment and maintenance of hardware finishes, during the final adjustment of hardware.
- E. Continued Maintenance Service: Approximately six months after the completion of the project, the Contractor accompanied by the Architectural Hardware Consultant, shall return to the project and re-adjust every item of hardware to restore proper functions of doors and hardware. Consult with and instruct Owner's personnel in recommended additions to the maintenance procedures. Replace hardware items which have deteriorated or failed due to faulty design, materials or installation of hardware units. Prepare a written report of current and predictable problems (of substantial nature) in the performance of the hardware.

3.4 HARDWARE LOCATIONS

- A. Conform to CCR, Title 24, Part 2; and ADAAG; and the drawings for access-compliant positioning requirements for the disabled.

3.5 FIELD QUALITY CONTROL

- A. Contractor is responsible for providing the services of an Architectural Hardware Consultant (AHC) or a proprietary product technician to inspect installation and certify that hardware and its installation have been furnished and installed in accordance with manufacturers' instructions and as specified herein.

3.6 HARDWARE SCHEDULE

- A. The items listed in the following schedule shall conform to the requirements of the foregoing specifications.
- B. While the hardware schedule is intended to cover all doors, and other movable parts of the building, and establish type and standard of quality, the contractor is responsible for examining the Plans and Specifications and furnishing proper hardware for all openings whether listed or not. If there are any omissions in hardware groups in regard to regular doors they shall be called to the attention of the Architect prior to bid opening for instruction; otherwise, list will be considered Complete. No extras will be allowed for omissions.
- C. The Door Schedule on the Drawings indicates which hardware set is used with each door.

MANUFACTURERS ABBREVIATIONS

GLY	=	Glynn-Johnson	Overhead Door Stops
HAG	=	Hager	Continuous Hinges
IVE	=	Ives	Hinges, Door Stops & Kick Plates
LCN	=	LCN	Door Closers
SCH	=	Schlage Lock	Locks, Latches & Cylinders
ZER	=	Zero International	Gasketing

HW GROUP NO. 1

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
1	EA	CONTINUOUS HINGE	780-224LL	628	HAG
1	EA	PASSAGE SET	L9010 06A XL11-515	630	SCH
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER

HW GROUP NO. 2

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PRIVACY LOCK W/IND	L9040 06A L583-363 L283-722	630	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	PERIMETER SEAL	BY ALUMINUM FRAME MFR		

UC DAVIS MEDICAL CENTER
DT1 #1745B CATH LAB REPLACE X-RAY EQUIPMENT
PROJECT NO. 9557230

HW GROUP NO. 3

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
1	EA	OVERHEAD STOP	90S RE-USE BALANCE OF EXISTING HARDWARE	630	GLY

HW GROUP NO. 4 - HARDWARE BY SLIDING DOOR MANUFACTURER

END OF SECTION

SECTION 08 83 00
MIRRORS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Glass mirrors.
 - 1. Annealed float glass.

1.02 REFERENCE STANDARDS

- A. ASTM C920 - Standard Specification for Elastomeric Joint Sealants 2018.
- B. ASTM C1036 - Standard Specification for Flat Glass 2021.
- C. GANA (TIPS) - Mirrors: Handle with Extreme Care (Tips for the Professional on the Care and Handling of Mirrors) 2011.

1.03 SUBMITTALS

- A. See Section 01 33 00 - Shop Drawings, Product Data, and Samples, for submittal procedures.
- B. Product Data on Mirror Types: Submit structural, physical and environmental characteristics, size limitations, special handling and installation requirements.

1.04 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer warranty for reflective coating on mirrors and replacement of same.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Mirror Design Criteria: Select materials and/or provide supports as required to limit mirror material deflection to 1/200, or to the flexure limit of glass, with full recovery of glazing materials, whichever is less.
- B. Mirror Glass; Type [____]: Clear, annealed float glass; ASTM C1036, with copper and silver coatings, and protective overcoating.

2.02 GLAZING COMPOUNDS

- A. Silicone Sealant; Type [____]: ASTM C920, Type S, Grade NS, Class 25, Uses M and A; single component; chemical or solvent curing; non-bleeding, non-staining, cured Shore A hardness of 15 to 25; [____] color.

2.03 ACCESSORIES

- A. Setting Blocks: Neoprene, 80 to 90 Shore A durometer hardness.
- B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness.
- C. Glazing Tape: Preformed butyl compound; 10 to 15 Shore A durometer hardness; on release paper.
- D. Glazing Clips: Manufacturer's standard type.
- E. Mirror Attachment Accessories: Stainless steel clips.
- F. Mirror Adhesive: Silicone pre-polymer based, chemically compatible with mirror coating and wall substrate.

PART 3 EXECUTION

3.01 EXAMINATION

3.02 PREPARATION

3.03 INSTALLATION

- A. Install mirrors in accordance with GANA (TIPS) and manufacturers recommendations.
- B. Set mirrors plumb and level, and free of optical distortion.
- C. Set mirrors with edge clearance free of surrounding construction including countertops or backsplashes.

3.04 CLEANING

END OF SECTION

SECTION 09 05 61
COMMON WORK RESULTS FOR FLOORING PREPARATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. This section applies to floors identified in contract documents that are receiving the following types of floor coverings:
 - 1. Resilient tile and sheet.
 - 2. Thin-set ceramic tile and stone tile.
- B. Removal of existing floor coverings.
- C. Preparation of new and existing concrete floor slabs for installation of floor coverings.
- D. Testing of concrete floor slabs for moisture and alkalinity (pH).
- E. Remediation of concrete floor slabs due to unsatisfactory moisture or alkalinity (pH) conditions.
 - 1. Contractor shall perform all specified remediation of concrete floor slabs. If such remediation is indicated by testing agency's report and is due to a condition not under Contractor's control or could not have been predicted by examination prior to entering into the contract, a contract modification will be issued.
- F. Patching compound.
- G. Remedial floor coatings.

1.02 RELATED REQUIREMENTS

- A. Section 01 22 00 - Unit Prices: Bid pricing for remediation treatments if required.
- B. Section 01 23 00 - Alternates: Bid pricing for remediation treatments if required.
- C. Section 01 41 00 - Regulatory Requirements: Additional requirements relating to testing agencies and testing.
- D. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions
- E. Section 03 54 00 - Cast Underlayment: Self-leveling underlayment applied as remediation treatment.

1.03 PRICE AND PAYMENT PROCEDURES

- A. Alternates : See Section 01 23 00 - Alternates.
- B. Unit Price for Alternate Flooring Adhesive: Do not include the cost of the alternate adhesive in the base bid; state on the bid form the unit price per square foot for using

the alternate adhesive, in the event such remediation is required.

1. Base the unit price on a total quantity calculated by assuming that only 50 percent of the flooring will require the alternate adhesive.
- C. Unit Price for Remedial Floor Coating: Do not include the cost of the floor coating or underlayment in the base bid; state on the bid form the unit price per square foot for the floor coating or underlayment, installed, in the event such remediation is required.
1. Base the unit price on a total quantity calculated by assuming that only 50 percent of the flooring will require the alternate adhesive.

1.04 REFERENCE STANDARDS

- A. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens) 2016a.
- B. ASTM C472 - Standard Test Methods for Physical Testing of Gypsum, Gypsum Plasters and Gypsum Concrete 1999 (Reapproved 2014).
- C. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring 2017.
- D. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride 2016a.
- E. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes 2017.
- F. ICRI 310.2R - Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair 2013.
- G. RFCI (RWP) - Recommended Work Practices for Removal of Resilient Floor Coverings 2011.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate scheduling of cleaning and testing, so that preliminary cleaning has been completed for at least 24 hours prior to testing.
- B. Contractor to provide both methods of moisture testing where moisture testing is recommended by flooring manufacturer.

1.06 SUBMITTALS

- A. Section 01 33 00 - Shop Drawings, Product Data, and Samples
- B. Visual Observation Report: For existing floor coverings to be removed.
- C. Floor Covering and Adhesive Manufacturers' Product Literature: For each specific combination of substrate, floor covering, and adhesive to be used; showing:

1. Moisture and alkalinity (pH) limits and test methods.
 2. Manufacturer's required bond/compatibility test procedure.
- D. Testing Agency's Report:
1. Description of areas tested; include floor plans and photographs if helpful.
 2. Summary of conditions encountered.
 3. Moisture and alkalinity (pH) test reports.
 4. Copies of specified test methods.
 5. Recommendations for remediation of unsatisfactory surfaces.
 6. Product data for recommended remedial coating.
 7. Submit report to Architect.
 8. Submit report not more than two business days after conclusion of testing.
- E. Adhesive Bond and Compatibility Test Report.
- F. Copy of RFCI (RWP).
- G. Remedial Materials Product Data: Manufacturer's published data on each product to be used for remediation.
1. Manufacturer's qualification statement.
 2. Manufacturer's statement of compatibility with types of flooring applied over remedial product.
 3. Test reports indicating compliance with specified performance requirements, performed by nationally recognized independent testing agency.
 4. Manufacturer's installation instructions.
 5. Specimen Warranty: Copy of warranty to be issued by coating manufacturer and certificate of underwriter's coverage of warranty.

1.07 QUALITY ASSURANCE

- A. Moisture and alkalinity (pH) testing shall be performed by an independent testing agency employed and paid by Contractor.
- B. Testing Agency Qualifications: Independent testing agency experienced in the types of testing specified.
1. Submit evidence of experience consisting of at least 3 test reports of the type required, with project Owner's project contact information.

- C. Contractor's Responsibility Relating to Independent Agency Testing:
 - 1. Provide access for and cooperate with testing agency.
 - 2. Confirm date of start of testing at least 10 days prior to actual start.
 - 3. Allow at least 4 business days on site for testing agency activities.
 - 4. Achieve and maintain specified ambient conditions.
 - 5. Notify Architect when specified ambient conditions have been achieved and when testing will start.
- D. Remedial Coating Installer Qualifications: Company specializing in performing work of the type specified in this section, trained by or employed by coating manufacturer, and able to provide at least 3 project references showing at least 3 years' experience installing moisture emission coatings.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, handle, and protect products in accordance with manufacturer's instructions and recommendations.
- B. Deliver materials in manufacturer's packaging; include installation instructions.
- C. Keep materials from freezing.

1.09 FIELD CONDITIONS

- A. Maintain ambient temperature in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 65 degrees F or more than 85 degrees F.
- B. Maintain relative humidity in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 40 percent and not more than 60 percent.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Volatile Organic Compound (VOC) Content: Comply with Section .01 61 16 - Volatile Organic Compound (VOC) Content Restrictions
- B. Patching Compound: Floor covering manufacturer's recommended product, suitable for conditions, and compatible with adhesive and floor covering. In the absence of any recommendation from flooring manufacturer, provide a product with the following characteristics:
 - 1. Cementitious moisture-, mildew-, and alkali-resistant compound, compatible with floor, floor covering, and floor covering adhesive, and capable of being feathered to nothing at edges.

2. Compressive Strength: 3000 psi, minimum, after 28 days, when tested in accordance with ASTM C109/C109M or ASTM C472, whichever is appropriate.
- C. Alternate Flooring Adhesive: Floor covering manufacturer's recommended product, suitable for the moisture and pH conditions present; low-VOC. In the absence of any recommendation from flooring manufacturer, provide a product recommended by adhesive manufacturer as suitable for substrate and floor covering and for conditions present.
- D. Remedial Floor Coating: Single- or multi-layer coating or coating/overlay combination intended by its manufacturer to resist water vapor transmission to degree sufficient to meet flooring manufacturer's emission limits, resistant to the level of alkalinity (pH) found, and suitable for adhesion of flooring without further treatment.
 1. Thickness: As required for application and in accordance with manufacturer's installation instructions.
 2. Basis of Design:
 - a. ARDEX Engineered Cements: www.ardexamericas.com.
 - 1) Concrete floor dormant crack remediation: ARDEX Ardifix
 - 2) Concrete floor remediation for moisture control issues: ARDEX MC Rapid
 - 3) Concrete floor self-leveling underlayment for floor flatness remediation: ARDEX P51 primer, ARDEX K15
 - 4) Concrete floor remediation for moisture control issues and self-leveling underlayment for floor flatness remediation: Basecoat ARDEX MC Rapid, Top Coat ARDEX K15
 3. Other Acceptable Manufacturers:
 - a. Floor Seal Technology, Inc: www.floorseal.com.
 - b. LATICRETE International, Inc: www.laticrete.com/#sle.
 - c. Sika Corporation; Sikafloor Moisture Tolerance Epoxy Primer: www.sikafloorusa.com.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.01 CONCRETE SLAB PREPARATION

- A. Follow recommendations of testing agency.
- B. Perform following operations in the order indicated:

1. Existing concrete slabs (on-grade and elevated) with existing floor coverings:
 - a. Visual observation of existing floor covering, for adhesion, water damage, alkaline deposits, and other defects.
 - b. Removal of existing floor covering.
 2. Preliminary cleaning.
 3. Moisture vapor emission tests; 3 tests in the first 1000 square feet and one test in each additional 1000 square feet, unless otherwise indicated or required by flooring manufacturer.
 4. Internal relative humidity tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
 5. Alkalinity (pH) tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
 6. Specified remediation, if required.
 7. Patching, smoothing, and leveling, as required.
 8. Other preparation specified.
 9. Adhesive bond and compatibility test.
 10. Protection.
- C. Remediations:
1. Active Water Leaks or Continuing Moisture Migration to Surface of Slab: Correct this condition before doing any other remediation; re-test after correction.
 2. Excessive Moisture Emission or Relative Humidity: If an adhesive that is resistant to the level of moisture present is available and acceptable to flooring manufacturer, use that adhesive for installation of the flooring; if not, apply remedial floor coating or remedial sheet membrane over entire suspect floor area.
 3. Excessive Alkalinity (pH): If remedial floor coating is necessary to address excessive moisture, no additional remediation is required; if not, if an adhesive that is resistant to the level present is available and acceptable to the flooring manufacturer, use that adhesive for installation of the flooring; otherwise, apply a skim coat of specified patching compound over entire suspect floor area.

3.02 REMOVAL OF EXISTING FLOOR COVERINGS

- A. Comply with local, State, and federal regulations and recommendations of RFCI Recommended Work Practices for Removal of Resilient Floor Coverings, as applicable to floor covering being removed.

- B. Dispose of removed materials in accordance with local, State, and federal regulations and as specified.

3.03 PRELIMINARY CLEANING

- A. Clean floors of dust, solvents, paint, permanent markers, wax, oil, grease, asphalt, residual adhesive, adhesive removers, film-forming curing compounds, sealing compounds, alkaline salts, excessive laitance, mold, mildew, and other materials that might prevent adhesive bond or telegraph through the flooring materials.
- B. Do not use solvents or other chemicals for cleaning.

3.04 MOISTURE VAPOR EMISSION TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
- C. Test in accordance with ASTM F1869 and as follows.
- D. Plastic sheet test and mat bond test may not be substituted for the specified ASTM test method, as those methods do not quantify the moisture content sufficiently.
- E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if test values exceed 3 pounds per 1000 square feet per 24 hours.
- F. Report: Report the information required by the test method.

3.05 INTERNAL RELATIVE HUMIDITY TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
- C. Test in accordance with ASTM F2170 Procedure A and as follows.
- D. Testing with electrical impedance or resistance apparatus may not be substituted for the specified ASTM test method, as the values determined are not comparable to the ASTM test values and do not quantify the moisture content sufficiently.
- E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if any test value exceeds 75 percent relative humidity.

- F. Report: Report the information required by the test method.

3.06 ALKALINITY TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. The following procedure is the equivalent of that described in ASTM F710, repeated here for the Contractor's convenience.
- C. Use a wide range alkalinity (pH) test paper, its associated chart, and distilled or deionized water.
- D. Place several drops of water on a clean surface of concrete, forming a puddle approximately 1 inch in diameter. Allow the puddle to set for approximately 60 seconds, then dip the alkalinity (pH) test paper into the water, remove it, and compare immediately to chart to determine alkalinity (pH) reading.
- E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if alkalinity (pH) test value is over 10.

3.07 PREPARATION

- A. See individual floor covering section(s) for additional requirements.
- B. Comply with recommendations of testing agency.
- C. Comply with requirements and recommendations of floor covering manufacturer.
- D. Concrete: Prepare surfaces according to ICRI 310.2R, CSP 4.
- E. Vacuum clean surfaces.
- F. Prime substrate in accordance with manufacturer's instructions. Allow to dry.
- G. Close floor openings.
- H. Fill and smooth surface cracks, grooves, depressions, control joints and other non-moving joints, and other irregularities with patching compound.
- I. Do not fill expansion joints, isolation joints, or other moving joints.

3.08 ADHESIVE BOND AND COMPATIBILITY TESTING

- A. Comply with requirements and recommendations of floor covering manufacturer.

3.09 APPLICATION OF REMEDIAL FLOOR COATING

- A. Comply with requirements and recommendations of coating manufacturer.

3.10 PROTECTION

- A. Cover prepared floors with building paper or other durable covering.

END OF SECTION

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SECTION 09 21 16
GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Performance criteria for gypsum board assemblies.
- B. Metal stud wall framing.
- C. Gypsum Board Suspension System
- D. Acoustic insulation.
- E. Cementitious backing board.
- F. Gypsum wallboard.
- G. Joint treatment and accessories.
- H. Acoustic (sound-dampening) wall and ceiling board.

1.02 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 07 84 00 - Firestopping: Top-of-wall assemblies at fire rated walls.
- C. Section 07 92 00 - Joint Sealants: Sealing acoustical gaps in construction other than gypsum board or plaster work.
- D. Section 09 22 16 - Non-Structural Metal Framing.
- E. Section 09 30 00 - Tiling: Tile backing board.
- F. Section 13 49 13 - Integrated X-ray Shielding Assemblies

1.03 REFERENCE STANDARDS

- A. AISI S100-12 - North American Specification for the Design of Cold-Formed Steel Structural Members 2012.
- B. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units 2018.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2022.
- D. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board 2017 (Reapproved 2022).

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- E. ASTM C635/C635M - Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings 2022.
- F. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members 2018.
- G. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing 2017.
- H. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products 2020.
- I. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board 2020.
- J. 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 2022.
- K. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs 2022.
- L. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base 2019.
- M. ASTM C1396/C1396M - Standard Specification for Gypsum Board 2017.
- N. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber 2021.
- O. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements 2009 (Reapproved 2016).
- P. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials 2022.
- Q. ASTM E413 - Classification for Rating Sound Insulation 2022.
- R. CBC - California Code of Regulations Title 24, Part 2, California Building Code; current edition.
- S. GA-216 - Application and Finishing of Gypsum Panel Products 2021.
- T. GA-226 - Application of Gypsum Board to Form Curved Surfaces 2019.
- U. ITS (DIR) - Directory of Listed Products Current Edition.
- V. UL 263 - Standard for Fire Tests of Building Construction and Materials Current Edition, Including All Revisions.

- W. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.
- X. UL (FRD) - Fire Resistance Directory Current Edition.

1.04 SUBMITTALS

- A. See Section 01 33 00 - Shop Drawings, Product Data, and Samples, for submittal procedures.
- B. Product Data: Provide data on metal framing, gypsum board, accessories, and joint finishing system.
- C. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing gypsum board installation and finishing, with minimum five years of documented experience.
- B. Copies of Documents at Site: Maintain at the project site a copy of each referenced document that prescribes execution requirements.

PART 2 PRODUCTS

2.01 GYPSUM BOARD ASSEMBLIES

- A. Provide completed assemblies complying with ASTM C840 and GA-216.
 - 1. See PART 3 for finishing requirements.
- B. Interior Partitions, Indicated as Sound-Rated: Provide completed assemblies with the following characteristics:
 - 1. Acoustic Attenuation: STC as indicated calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.
- C. Fire Rated Assemblies: Provide completed assemblies with the indicated fire-resistance rating that conforms with the fire exposure and acceptance criteria specified in ASTM E119. Fire-resistance ratings shall be established by any of the following methods or procedures:
 - 1. Prescriptive design of fire-resistance-rated building elements, components or assemblies per CBC Section 721.
 - 2. Calculations in accordance with Section 722.
 - 3. Fire-resistance designs certified by an Approved Agency.
 - 4. Fire-resistance designs having fire-resistance ratings as determined by the test procedure set forth in ASTM E119 or UL 263 and certified by an Approved Testing

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- a. UL Assembly Numbers: Provide construction equivalent to that listed for the particular assembly in the current UL (FRD).
 - b. Intertek Testing Services/Warnock Hersey International/Omega Point Laboratories Assembly Design Numbers: Provide construction equivalent to that listed for the particular assembly in the current ITS (DIR).
5. Engineering Judgements (EJ): Engineering analysis based on a comparison of building element, component or assemblies designs having fire-resistance ratings as determined by the test procedure set forth in ASTM E119 or UL 263.
Requirements for Engineering Judgements:
- a. Prepared and signed by a registered Professional Engineer or Fire Protection Engineer who shall be knowledgeable regarding the elements of the construction to be protected, probable behavior of that construction and the recommended system protecting it. Provide documentation of Engineer's qualifications.
 - b. Provide existing tested, listed systems that are comparable in application of cover equivalent conditions that shall be used as the basis for the EJ.
 - c. The EJ shall apply only to the specific conditions and configurations for which it was produced and shall be based upon reasonable performance expectations for the recommended fire-resistive system for the specific application.
 - d. EJs are approved for a specific condition on a project-by-project basis and shall not be used for another project or condition without thorough and appropriate review of all aspects of the EJ as it relates to that project's circumstances.
 - e. EJs shall be presented in a narrative format that clearly describes all aspects of the design, including, but not limited to the hourly rating required, a complete description of all critical elements for the fire-resistive system configuration, any non-standard conditions, clear directions for the installation of the recommended system and the fire-resistive design(s) that the EJ is based on. Detailed drawings shall be included when deemed necessary to clearly illustrate the assembly.
 - f. EJs shall clearly state that the recommended system is an engineering judgment and is NOT a listed system.
 - g. EJs shall indicate the facility name, address, title of project, AHJ project/permit number, and include the issuer's name, title, address, telephone number and signature.

2.02 METAL FRAMING MATERIALS

- A. Manufacturers - Metal Framing, Connectors, and Accessories:
 - 1. Basis of Design;
 - a. CEMCO; www.cemcosteel.com
 - 2. Acceptable Manufacturers:
 - a. Clarkwestern Dietrich Building Systems LLC: www.clarkdietrich.com.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Non-Loadbearing Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/240 at 10 psf.
 - 1. Studs: "C" shaped with flat or formed webs with knurled faces.
 - 2. Runners: U shaped, sized to match studs.
 - 3. Furring: Hat-shaped sections, minimum depth of 7/8 inch.
 - 4. Resilient Furring Channels: 1/2 inch depth, for attachment to substrate through both legs; both legs expanded metal mesh.
 - a. Products:
 - 1) Same manufacturer as other framing materials.
- C. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection using slotted holes, screws and anti-friction bushings, preventing rotation of studs while maintaining structural performance of partition.
 - 1. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI S100-12.
 - 2. Material: ASTM A653/A653M steel sheet, SS Grade 50/340, with G60/Z180 hot dipped galvanized coating.
 - 3. Provide components UL-listed for use in UL-listed fire-rated head of partition joint systems specified in this section.
 - 4. Deflection and Firestop Track:
 - a. Provide mechanical anchorage devices as described above that accommodate deflection while maintaining the fire-rating of the wall assembly.
 - 5. Products:

- a. FireTrak Corporation; Posi Klip.
- b. Metal-Lite, Inc; The System.
- c. Substitutions: See Section 01 60 00 - Product Requirements.

2.03 GYPSUM BOARD SUSPENSION SYSTEM

- A. Gypsum board suspension system conforming to ASTM C635/C635M
 1. Classification; Heavy Duty
 2. Size: 1.6 x 1.5 inches.
 3. Finish: G40 hot dip galvanized.
- B. Basis of Design:
 1. CertainTeed Corporation; HD-FR 1.5 inch system: www.certainteed.com/ceilings.
- C. Acceptable Manufacturers:
 1. USG Corporation: www.usg.com.
 2. Substitutions: See Section 01 60 00 - Product Requirements.

2.04 BOARD MATERIALS

- A. Manufacturers - Gypsum-Based Board:
 1. Basis of Design:
 - a. USG Corporation; www.usg.com.
- B. Acceptable Manufacturers:
 1. CertainTeed Corporation: www.certainteed.com.
 2. Georgia-Pacific Gypsum: www.gpgypsum.com.
 3. National Gypsum Company: www.nationalgypsum.com/#sle.
 4. PABCO Gypsum: www.pabco gypsum.com.
 5. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
 1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.

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- a. Mold resistant board is required at all locations.
- 3. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
- 4. Thickness:
 - a. Vertical Surfaces: 5/8 inch.
 - b. Ceilings: 1/2 inch.
- D. Backing Board For Non-Wet Areas: Water-resistant gypsum backing board as defined in ASTM C1396/C1396M; sizes to minimum joints in place; ends square cut.
 - 1. Application: Vertical surfaces behind thinset tile, except in wet areas.
 - 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 - 3. Type: Regular and Type X, in locations indicated.
 - 4. Type X Thickness: 5/8 inch.
 - 5. Regular Board Thickness: 5/8 inch.
 - 6. Edges: Tapered.
 - 7. Products:
 - a. Same manufacturer as board materials.
- E. Ceiling Board: Special sag resistant gypsum ceiling board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
 - 1. Application: Ceilings, unless otherwise indicated.
 - 2. Thickness: 1/2 inch.
 - 3. Edges: Tapered.
 - 4. Products:
 - a. Same manufacturer as board materials.
- F. Acoustical Sound Dampening Wall and Ceiling Board: Two layers of heavy paper faced, high density gypsum board separated by a viscoelastic polymer layer and capable of achieving STC rating of 50 or more in typical stud wall assemblies as calculated in accordance with ASTM E413 and when tested in accordance with ASTM E90.
 - 1. Thickness: 5/8 inch.
 - 2. Long Edges: Tapered.

3. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
4. Basis of Design:
 - a. Pabco Gypsum; QuitRock ES Mold Resistant: www.quietrock.com.
5. Acceptable Products:
 - a. National Gypsum Company; Gold Bond SoundBreak XP Gypsum Board: www.nationalgypsum.com/#sle.
 - b. CertainTeed; SilentFX
 - c. Substitutions: See Section 01 60 00 - Product Requirements.

2.05 ACCESSORIES

- A. Acoustic Insulation: ASTM C665; preformed glass fiber, friction fit type, unfaced. Thickness: 2 inch.
 1. Flame spread index of not more than 25 per UL 723 Test for Surface Burning Characteristics.
 2. Underwriters Laboratory (UL) Certification under category BKNV with designation FHC 25/50.
- B. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.
- C. Finishing Accessories: ASTM C1047, galvanized steel or rolled zinc, unless noted otherwise.
 1. Types: As detailed or required for finished appearance.
 2. Special Shapes: In addition to conventional corner bead and control joints, provide U-bead at exposed panel edges.
- D. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
 1. Tape: 2 inch wide, creased paper tape for joints and corners, except as otherwise indicated.
 2. Ready-mixed vinyl-based joint compound.
- E. High Build Drywall Surfer: Vinyl acrylic latex-based coating for spray application, designed to take the place of skim coating and separate paint primer in achieving Level 5 finish.
 1. Basis of Design:
 - a. USG Corporation; Tuff-Hide: www.usg.com.

2. Acceptable Products:

- a. Hamilton Drywall Products; Hamilton Prep Coat.: www.hamiltonnw.com
 - b. Solid Products, Inc.: Fast 5 Drywall Surfacers: solidproductsinc.com.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
- F. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inch in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion resistant.
- G. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch in Thickness: ASTM C954; steel drill screws, corrosion resistant.
- H. Anchorage to Substrate: Tie wire, nails, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that project conditions are appropriate for work of this section to commence.

3.02 SHAFT WALL INSTALLATION

- A. Shaft Wall Liner: Cut panels to accurate dimension and install sequentially between special friction studs.

3.03 FRAMING INSTALLATION

- A. Metal Framing: Install in accordance with ASTM C754 and manufacturer's instructions.
- B. Studs: Space studs as indicated.
- 1. Extend partition framing as indicated on Drawings.
 - 2. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
 - 3. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.
- C. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.
- D. Standard Wall Furring: Install at concrete walls scheduled to receive gypsum board, not more than 4 inches from floor and ceiling lines and abutting walls. Secure in place on alternate channel flanges at maximum 24 inches on center.

1. Orientation: Horizontal.
 2. Spacing: As indicated.
- E. Blocking: Install mechanically fastened steel channel blocking for support of:
1. Framed openings.
 2. Wall mounted cabinets.
 3. Plumbing fixtures.
 4. Toilet partitions.
 5. Toilet accessories.
 6. Wall mounted door hardware.
 7. Medical equipment.

3.04 ACOUSTIC ACCESSORIES INSTALLATION

- A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
- B. Acoustic Sealant: Install in accordance with manufacturer's instructions.
1. Place one bead continuously on substrate before installation of perimeter framing members.
 2. Seal around all penetrations by conduit, pipe, ducts, and rough-in boxes, except where firestopping is provided.

3.05 BOARD INSTALLATION

- A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
- B. Single-Layer Non-Rated: Install gypsum board parallel to framing, with ends and edges occurring over firm bearing.
- C. Double-Layer Non-Rated: Use gypsum board for first layer, placed parallel to framing or furring members, with ends and edges occurring over firm bearing. Use glass mat faced gypsum board at exterior walls and at other locations as indicated. Place second layer perpendicular to framing or furring members. Offset joints of second layer from joints of first layer.
- D. Fire-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.

- E. Cementitious Backing Board: Install over steel framing members and plywood substrate where indicated, in accordance with ANSI A108.11 and manufacturer's instructions.
- F. Installation on Metal Framing: Use screws for attachment of gypsum board except face layer of non-rated double-layer assemblies, which may be installed by means of adhesive lamination.
- G. Curved Surfaces: Apply gypsum board to curved substrates in accordance with GA-226.

3.06 INSTALLATION OF TRIM AND ACCESSORIES

- A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
 - 1. Not more than 30 feet apart on walls and ceilings over 50 feet long.
- B. Corner Beads: Install at external corners, using longest practical lengths.
- C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

3.07 JOINT TREATMENT

- A. Paper Faced Gypsum Board: Use paper joint tape, bedded with ready-mixed vinyl-based joint compound and finished with ready-mixed vinyl-based joint compound.
- B. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
 - 1. Level 5: Walls and ceilings to receive semi-gloss or gloss paint finish and other areas specifically indicated.
 - 2. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
 - 3. Level 3: Not used.
 - 4. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
 - 5. Level 1: Fire rated wall areas above finished ceilings, whether or not accessible in the completed construction.
 - 6. Level 0: Temporary partitions.
- C. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
 - 1. Feather coats of joint compound so that camber is maximum 1/32 inch.
- D. Where Level 5 finish is indicated, spray apply high build drywall surfacer over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.

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- E. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

3.08 TOLERANCES

- A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

END OF SECTION

SECTION 09 22 16
NON-STRUCTURAL METAL FRAMING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Metal partition, ceiling, and soffit framing.
- B. Engineered header system.
- C. Framing accessories.

1.02 RELATED REQUIREMENTS

- A. Section 05 40 00 - Cold-Formed Metal Framing: Structural load bearing metal stud framing and Exterior wall stud framing.
- B. Section 05 40 00 - Cold-Formed Metal Framing: Execution requirements for anchors for attaching work of this section.
- C. Section 07 21 00 - Thermal Insulation: Acoustic insulation.
- D. Section 07 84 00 - Firestopping: Sealing top-of-wall assemblies at fire rated walls.
- E. Section 07 92 00 - Joint Sealants: Sealing acoustical gaps in construction other than gypsum board or plaster work.
- F. Section 08 31 00 - Access Doors and Panels.
- G. Section 09 21 16 - Gypsum Board Assemblies: Metal studs for gypsum board partition framing.
- H. Section 09 21 16 - Gypsum Board Assemblies: Execution requirements for anchors for attaching work of this section.

1.03 REFERENCE STANDARDS

- A. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products 2020.
- B. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs 2022.
- C. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements 2009 (Reapproved 2016).
- D. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic) 2019.

1.04 SUBMITTALS

- A. Shop Drawings:
 - 1. Indicate engineered header system component details maximum span tables configuration layout and load carrying capacity of headers.
 - 2. Describe method for securing studs to tracks, splicing, and for blocking and reinforcement of framing connections.
- B. Product Data: Provide data describing framing member materials and finish, engineered header system., product criteria, engineered header system., load charts, engineered header system., limitations, engineered header system., and engineered header system..
- C. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
- D. Engineering Calculations for Engineered Header System: Submit engineering calculations prepared by a California licensed Professional Engineer. Include uniform lateral loads and allowable lateral loads for header members.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the work of this section with minimum five years documented experience and approved by manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Metal Framing, Connectors, and Accessories:
- B. Basis of Design:
 - 1. CEMCO; Metal Framing: www.cemcosteel.com/#sle.
 - 2. ClarkDietrich Building Systems; [_____]: www.clarkdietrich.com/#sle.
 - 3. Brady Construction Inovations, Inc.; ProX Header - Engineered Metal Framing Header System: www.proxheader.com

2.02 FRAMING MATERIALS

- A. Fire Rated Assemblies: Comply with applicable code and as follows:
- B. Engineered Header System: ProX Header - Engineered Metal Framing Header System.
- C. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection using slotted holes, screws and anti-friction bushings, preventing rotation of studs while maintaining structural performance of partition.

1. Provide components UL-listed for use in UL-listed fire-rated head of partition joint systems indicated on drawings.
 2. Provide top track preassembled with connection devices spaced to fit stud spacing indicated on drawings; minimum track length of 12 feet.
- D. Tracks and Runners: Same material and thickness as studs, bent leg retainer notched to receive studs with provision for crimp locking to stud.
- E. Furring and Bracing Members: Of same material as studs; thickness to suit purpose; complying with applicable requirements of ASTM C754.
- F. Fasteners: ASTM C1002 self-piercing tapping screws.
- G. Notched Metal Stud Backing: 0598 inch thick, galvanized.
- H. Anchorage Devices: Powder actuated or Drilled expansion bolts.
- I. Acoustic Insulation: As specified in Section 07 21 00.
- J. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.
- K. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic.

2.03 FABRICATION

- A. Fabricate assemblies of framed sections to sizes and profiles required.
- B. Fit, reinforce, and brace framing members to suit design requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that rough-in utilities are in proper location.

3.02 TOLERANCES

- A. Maximum Variation From True Position: 1/8 inch in 10 feet.
- B. Maximum Variation From Plumb: 1/8 inch in 10 feet.

END OF SECTION

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**SECTION 09 30 00
TILING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Tile for floor applications.
- B. Tile for wall applications.
- C. Tile for counters.
- D. Solid surfacing thresholds.
- E. Ceramic trim.
- F. Non-ceramic trim.

1.02 RELATED REQUIREMENTS

- A. Section 03 54 00 - Cast Underlayment.
- B. Section 07 14 00 - Fluid-Applied Waterproofing.
- C. Section 07 92 00 - Joint Sealants: Sealing joints between tile work and adjacent construction and fixtures.
- D. Section 09 05 62 - Common Work Results for Flooring Preparation.
- E. Section 09 21 16 - Gypsum Board Assemblies: Tile backer board.
- F. Section 09 30 50 - Tile Setting Materials and Accessories - Ceramic tile trims
- G. Section 22 40 00 - Plumbing Fixtures: Shower receptor.

1.03 REFERENCE STANDARDS

- A. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar 2017.
- B. ANSI A108.1b - American National Standard Specifications for Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex-Portland Cement Mortar 2017.
- C. ANSI A108.1c - Contractor's Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex-Portland Cement Mortar 1999 (Reaffirmed 2021).
- D. ANSI A108.4 - American National Standard Specifications for Installation of Ceramic Tile with Organic Adhesive or Water Cleanable Tile-Setting Epoxy Adhesive 2019.

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- E. ANSI A108.5 - American National Standard Specifications for Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar 2021.
- F. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grout Epoxy 1999 (Reaffirmed 2019).
- G. ANSI A108.8 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant Furan Resin Mortar and Grout 1999 (Reaffirmed 2019).
- H. ANSI A108.9 - American National Standard Specifications for Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout 1999 (Reaffirmed 2019).
- I. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework 2017.
- J. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units 2018.
- K. ANSI A108.12 - American National Standard for Installation of Ceramic Tile with EGP (Exterior Glue Plywood) Latex-Portland Cement Mortar 1999 (Reaffirmed 2019).
- L. ANSI A108.13 - American National Standard for Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone 2005 (Reaffirmed 2021).
- M. ANSI A118.1 - American National Standard Specifications for Dry-Set Cement Mortar 2019.
- N. ANSI A118.3 - American National Standard Specifications for Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy and Water Cleanable Tile-Setting Epoxy Adhesive 2021.
- O. ANSI A118.6 - American National Standard Specifications for Standard Cement Grouts for Tile Installation 2019.
- P. ANSI A118.10 - American National Standard Specifications for Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone 2014 (Reaffirmed 2019).
- Q. ANSI A118.12 - American National Standard Specifications for Crack Isolation Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation 2014 (Reaffirmed 2019).
- R. ANSI A118.13 - American National Standard Specification for Bonded Sound Reduction Membranes for Thin-Set Ceramic Tile Installation 2014 (Reaffirmed 2019).
- S. ANSI A118.15 - American National Standard Specifications for Improved Modified Dry-Set Cement Mortar 2019.
- T. ANSI A137.1 - American National Standard Specifications for Ceramic Tile 2022.

- U. ASTM C373 - Standard Test Methods for Determination of Water Absorption and Associated Properties by Vacuum Method for Pressed Ceramic Tiles and Glass Tiles and Boil Method for Extruded Ceramic Tiles and Non-tile Fired Ceramic Whiteware Products 2018.
- V. ASTM C847 - Standard Specification for Metal Lath 2018.
- W. ASTM E492 - Standard Test Method for Laboratory Measurement of Impact Sound Transmission through Floor-Ceiling Assemblies Using the Tapping Machine 2022.
- X. ASTM E2179 - Standard Test Method for Laboratory Measurement of the Effectiveness of Floor Coverings in Reducing Impact Sound Transmission Through Concrete Floors 2021.
- Y. ISO 13007 - Standards for Ceramic Tiles, Adhesives and Grouts; current edition
- Z. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation 2022.

1.04 SUBMITTALS

- A. See Section 01 33 00 - Shop Drawings, Product Data, and Samples, for submittal procedures.
- B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.
- C. Shop Drawings: Indicate tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, ceramic accessories, and setting details.
- D. Samples: Mount tile and apply grout on two plywood panels, minimum 18 by 18 inches in size illustrating pattern, color variations, and grout joint size variations.
- E. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum five years of documented experience.
- B. Installer Qualifications: Company specializing in performing tile installation, with minimum of five years of documented experience.

1.06 MOCK-UP

- A. See Section 01 43 00 - Mockup, for general requirements for mock-up.
- B. Construct tile mock-up where indicated on drawings, incorporating all components specified for the location.

1. Provide 3 foot x 3 foot mockup.
2. Provide a minimum of 80 foot candles of light to simulate actual finished field conditions.
3. Approved mock-up may remain as part of the Work.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

1.08 FIELD CONDITIONS

- A. Do not install solvent-based products in an unventilated environment.
- B. Maintain ambient and substrate temperature of 50 degrees F during installation of mortar materials.

PART 2 PRODUCTS

2.01 TILE

- A. Basis of Design Manufacturer:
 1. Refer to Interior Design Drawings, Sheet ID600..
- B. Ceramic Mosaic Tile: ANSI A137.1 standard grade.
 1. Moisture Absorption: 0 to 0.5 percent as tested in accordance with ASTM C373.
 2. Color(s): As indicated on drawings.
 3. Pattern: As indicated on drawings.
- C. Porcelain Tile: ANSI A137.1, standard grade.
 1. Abrasion Resistance: ISO 10545-7; PEI 5.
 2. Thermal Shock Resistance: ISO 10545-9; Resistant.
 3. Frost Resistance: ISO 10545-12; Resistant.
 4. Chemical Resistance: ISO 10545-13; Resistant.
 5. Pattern: As shown on the Drawings.

2.02 TRIM AND ACCESSORIES

- A. Ceramic Trim: Matching bullnose ceramic shapes in sizes coordinated with field tile.
 1. Applications:

- a. Open Edges: Bullnose.
 - b. Inside Corners: Jointed.
 - c. Floor to Wall Joints: Straight base.
- 2. Manufacturers: Same as for tile.
- B. Non-Ceramic Trim: Trims specified in Section 09 30 50
 - 1. Applications:
 - a. Open edges of wall tile.
 - b. Borders and other trim as indicated on drawings.
- C. Thresholds: Solid Surfacing.
 - 1. Basis of Design Product: DuPont Corian.
 - 2. Color: As shown on the Interior Design Drawings..
 - 3. Size; 6 inches wide minimum unless otherwise shown on the drawings by full width of wall or frame opening; 1 inch thick; beveled one long edge with radius corners on top side; without holes, cracks, or seams.
 - 4. Applications:
 - a. At shower transitions between Tile and Epoxy Floor.

2.03 SETTING MATERIALS

- A. Improved Latex-Portland Cement Mortar Bond Coat: ANSI A118.15 and ISO 13007: C2ES2.
 - 1. Basis of Design:
 - a. Custom Building Products; MegaLite Ultimate Crack Prevention Large Format Tile Mortar: www.custombuildingproducts.com.
 - 2. Other Accpetable Products:
 - a. ARDEX Engineered Cements; ARDEX S 28 MICROTEC: www.ardexamericas.com.
 - b. LATICRETE International, Inc; LATICRETE 254 Platinum: www.laticrete.com/#sle.
 - c. MAPEI Corporation; UltraFlex 3: www.mapei.com;
 - d. Substitutions: See Section 01 60 00 - Product Requirements.

- B. Epoxy Adhesive and Mortar Bond Coat: ANSI A118.3.
 - 1. Applications: Where indicated on drawings.
 - 2. Basis of Design Product:
 - a. Custom Building Products: www.custombuildingproducts.com.
 - 3. Acceptable Manufacturers:
 - a. LATICRETE International, Inc; LATICRETE LATAPOXY 300 Adhesive: www.laticrete.com/#sle.
 - b. MAPEI Corporation: <http://www.Mapei.com>; Kerapoxy 410.
- C. Dry-Set Portland Cement Mortar Bond Coat: ANSI A118.1.
 - 1. Basis of Design Product:
 - a. Custom Building Products: www.custombuildingproducts.com.
 - 2. Acceptable Manufacturers:
 - a. MAPEI Corporation: <http://www.Mapei.com>; Kerabond T.
- D. Mortar Bed Materials: Pre-packaged mix of Portland cement, sand, latex additive, and water.
 - 1. Basis of Design Product:
 - a. Custom Building Products: www.custombuildingproducts.com.
 - 2. Acceptable Manufacturers:
 - a. MAPEI Corporation: Modified Mortar Bed; <http://www.Mapei.com>
 - 3. Substitutions: See Section 01 60 00 - Product Requirements.

2.04 GROUTS

- A. Manufacturers:
 - 1. Basis of Design:
 - a. Custom Building Products: <http://www.custombuildingproducts.com>
 - 2. Acceptable Manufacturers:
 - a. LATICRETE International, Inc; LATICRETE PERMACOLOR Grout: www.laticrete.com/#sle.
 - b. MAPEI Corporation: UltraColor Plus; <http://www.Mapei.com>

3. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Standard Grout: ANSI A118.6 standard cement grout.
 1. Applications: Use this type of grout where indicated .
 2. Use sanded grout for joints 1/8 inch wide and larger; use unsanded grout for joints less than 1/8 inch wide.
 3. Color(s): Refer to Interior Design Drawings, Sheet I-600.
- C. Stain Resistant Grout Additive: Liquid admixture for sanded and unsanded cement-based grouts; mix with dry grout material in place of water.
 1. Applications: Where indicated.
 2. Products:

2.05 MAINTENANCE MATERIALS

- A. Tile Sealant: Gunnable, silicone, siliconized acrylic, or urethane sealant; moisture and mildew resistant type.
 1. Applications: Between tile and plumbing fixtures.
 2. Color(s): As selected by Architect from manufacturer's full line.
 3. Products:
 - a. Custom Building Products; Commercial 100% Silicone Caulk: www.custombuildingproducts.com/#sle.
 - b. LATICRETE International, Inc; LATICRETE LATASIL: www.laticrete.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Grout Sealer: Liquid-applied, moisture and stain protection for existing or new Portland cement grout.
 1. Composition: Water-based colorless silicone.
 2. Products:
 - a. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Tile Sealer: Stain protection for natural stone.
 1. Products:
 - a. STONETECH, a division of LATICRETE international, Inc; STONETECH Heavy Duty Stone Sealer: www.laticrete.com/#sle.

- b. Substitutions: See Section 01 60 00 - Product Requirements.

2.06 ACCESSORY MATERIALS

- A. Concrete Floor Slab Crack Isolation Membrane: Material complying with ANSI A118.10 and A118.12.
1. Thickness: 30 mils, maximum.
 2. Crack Resistance: No failure at 1/16 inch gap, minimum.
 3. Products:
 - a. Basis of Design:
 - 1) Custom Building Products; RedGard Waterproofing and Crack Isolation Prevention Membrane; <http://www.custombuildingproducts.com>
 - b. Acceptable Manufacturers:
 - 1) LATICRETE International, Inc; LATICRETE Blue 92 Anti-Fracture Membrane: www.laticrete.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Reinforcing Mesh: 2 by 2 inch size weave of 16/16 wire size; welded fabric, galvanized.
- C. Metal Lath: ASTM C847 Flat diamond mesh, of weight to suit application, galvanized finish.
- D. Underlayment at Floors: Specifically designed for bonding to thin-set setting mortar; not primarily a waterproofing material and having the following characteristics:
1. Sound Reduction: Comply with ANSI A118.13 bonded membrane, ASTM E2179, ASTM E492, ANSI A118.13 bonded membrane, ASTM E2179, ASTM E492, ANSI A118.13 bonded membrane, ASTM E2179, and ASTM E492.
 2. Crack Resistance: No failure at 1/16 inch gap, minimum; comply with ANSI A118.12.
 3. Water Resistance: Comply with ANSI A118.10, bonded waterproofing.
 4. Type: Fluid or Trowel Applied.
 - a. Products:
 - 1) Custom Building Products; FractureFree Crack Prevention Membrane; <http://www.custombuildingproducts.com>
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.

- E. Backer Board: Refer to Section 09 21 16 - Gypsum Board Assemblies.
- F. Mesh Tape: 2 inch wide self-adhesive fiberglass mesh tape.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that sub-floor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.
- C. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of setting materials to sub-floor surfaces.
- D. Verify that concrete sub-floor surfaces are ready for tile installation by testing for moisture emission rate and alkalinity; obtain instructions if test results are not within limits recommended by tile manufacturer and setting materials manufacturer. Refer to Section 09 05 62 - Common Work Results for Flooring.
- E. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

- A. Protect surrounding work from damage.
- B. Vacuum clean surfaces and damp clean.
- C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.
- D. Install backer board in accordance with ANSI A108.11 and board manufacturer's instructions. Tape joints and corners, cover with skim coat of setting material to a feather edge.
- E. Prepare substrate surfaces for adhesive installation in accordance with adhesive manufacturer's instructions.

3.03 INSTALLATION - GENERAL

- A. Install tile, thresholds, and stair treads and grout in accordance with applicable requirements of ANSI A108.1a through ANSI A108.13, manufacturer's instructions, and TCNA (HB) recommendations.
- B. Shuffle tile boxes and box contents prior to installation for random color range dispersion.
- C. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.

- D. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.
- E. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.
- F. Form internal angles square and external angles bullnosed.
- G. Install non-ceramic trim in accordance with manufacturer's instructions.
- H. Sound tile after setting. Replace hollow sounding units.
- I. Prior to grouting, allow installation to completely cure; minimum of 48 hours.
- J. Grout tile joints unless otherwise indicated.
- K. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.

3.04 INSTALLATION - FLOORS - THIN-SET METHODS

- A. Over interior concrete substrates, install in accordance with TCNA (HB) Method F113, dry-set or latex-Portland cement bond coat, with standard grout, unless otherwise indicated.
 - 1. Use uncoupling membrane under all tile unless other underlayment is indicated.
 - 2. Where waterproofing membrane is indicated, install in accordance with TCNA (HB) Method F122, with latex-Portland cement grout.
- B. Install tile-to-tile floor movement joints in accordance with TCNA (HB) Method EJ171F.

3.05 INSTALLATION - WALL TILE

- A. Over cementitious backer units over gypsum board on studs, install in accordance with TCNA (HB) Method W244C .

3.06 CLEANING

- A. Clean tile and grout surfaces.

3.07 PROTECTION

- A. Do not permit traffic over finished floor surface for 4 days after installation.

END OF SECTION

SECTION 09 30 50
TILE SETTING MATERIALS AND ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Edge-protection and transition profiles for floors.
- B. Finishing and edge-protection profiles for walls and countertops.

1.02 RELATED SECTIONS

- A. Section 09 30 00 - Tiling.

1.03 REFERENCES

- A. CSA B79-08: Floor, Area, and Shower Drains, and Cleanouts for Residential Construction.
- B. IAPMO IGC 195: Interim Guide Criteria for Floor Drain with Integrated Bonding Flange.
- C. Tile Council of North America (TCNA) Handbook for Ceramic Tile Installation.
- D. Terrazzo, Tile and Marble Association of Canada (TTMAC) Specification Guide 09300 Tile Installation Manual.
- E. American National Standard Specifications for the installation of ceramic tile A108 / A118 / A136.1.

1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00 - Shop Drawings, Product Data, and Samples.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- C. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) long, representing actual product, color, and finish.
- D. Manufacturer's Certificates: Certify products meet or exceed specified requirements.
- E. Warranty document showing duration and scope to be submitted with product submittals.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the work of this section with minimum five years' experience.
- B. Source Limitations for Setting Materials and Accessories: Obtain product of a uniform quality for each application condition from a single manufacturer.
- C. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
 - 1. Finish areas designated by Architect.
 - 2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
 - 3. Refinish mock-up area as required to produce acceptable work.
- D. Preinstallation Conference: Conduct conference at the Project site.
 - 1. Convene one week prior to commencing work of this section.
 - 2. Require attendance of installation material manufacturer, tile supplier, tile installer and installers of related work. Review installation procedures and coordination required with related work.
 - 3. Meeting agenda includes but is not limited to:
 - a. Surface preparation.
 - b. Tile and installation material compatibility.
 - c. Manufacturer and installer warranty duration and scope covered by warranty.
 - d. Edge protection, transition, and pre-fabricated movement joint profiles.
 - e. Waterproofing techniques.
 - f. Crack isolation techniques.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Protect materials from exposure to moisture. Do not deliver until after wet work is complete and dry.
- C. Store materials in a dry, warm, ventilated weathertight location.

1.07 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.08 WARRANTY

- A. Provide sample warranty during submittal process.
- B. Acknowledge warranty duration and scope covered by warranty.
- C. Coordinate Work with other operations and installation of floor finish materials to avoid damage to installed materials.
- D. Obtain products of a uniform quality for each premanufactured tile profile, and mortar and waterproofing and uncoupling membrane from a single manufacturer, to maintain the installation system and provide multi-product warranty from selected manufacturer.

1.09 COORDINATION

- A. Coordinate Work with other operations and installation of floor finish materials to avoid damage to installed materials.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturer: Schluter Systems L.P., which is located at: 194 Pleasant Ridge Road.; Plattsburgh, NY 12901-5841; ASD Toll Free Tel: 800-472-4588; Fax: 800-477-9783; Email:specassist@schluter.com; Web:www.schluter.com/schluter-us/en_US/.
- B. Acceptable Manufacturer: Schluter Systems (Canada) Inc., 21100 Chemin Ste-Marie, Ste-Anne-de-Bellevue, QC H9X 3Y8. Tel: (800) 667-8746. Fax (514) 336-2410. Email:specassist@schluter.com; Web:www.schluter.ca.
- C. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00.

2.02 EDGE-PROTECTION AND TRANSITION PROFILES FOR FLOORS

- A. Schluter-SCHIENE: L-shaped profile with 1/8 inch (3 mm) wide visible surface integrated trapezoid-perforated anchoring leg, and integrated grout joint spacer.
 - 1. Profile Height: As required to coordinate with tile selection and setting system.
 - 2. Material and Finish:
 - a. AE: Satin Anodized Aluminum.

2.03 FINISHING AND EDGE-PROTECTION PROFILES FOR WALLS AND COUNTERTOPS

- A. Schluter-JOLLY: L-shaped profile. 1/8 inch (3 mm) wide top and vertical wall sections that together form the visible surface. Integrated trapezoid-perforated anchoring leg, and integrated grout joint spacer.
 - 1. Anchoring Leg: Straight anchoring leg.
 - 2. Profile Height: As required to coordinate with tile selection and setting system.
 - 3. Material and Finish:
 - a. AT: Satin Nickel Anodized Aluminum.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

3.04 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 09 51 00
ACOUSTICAL CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Suspended metal grid ceiling system.
- B. Acoustical tile.

1.02 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 07 21 00 - Thermal Insulation: Acoustical insulation.
- C. Section 08 31 00 - Access Doors and Panels: Access panels.
- D. Section 21 05 10 - Basic Materials and Methods for Wet Pipe Sprinkler systems: Sprinkler heads in ceiling system.
- E. Section 23 37 13 - Diffusers Registers and Grilles: Air diffusion devices in ceiling.
- F. Section 26 51 13 - Lighting Fixtures: Light fixtures in ceiling system.
- G. Section 28 46 00 - Fire Detection and Alarm: Fire alarm components in ceiling system.

1.03 REFERENCE STANDARDS

- A. ASTM C635/C635M - Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings 2022.
- B. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels 2019.
- C. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions 2022.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
- B. Do not install acoustical units until after interior wet work is dry.

1.05 SUBMITTALS

- A. See Section 01 33 00 - Shop Drawings, Product Data, and Samples, for submittal procedures.
- B. Shop Drawings: Indicate grid layout and related dimensioning.
- C. Product Data: Provide data on suspension system components.
- D. Samples: Submit two samples 4 by 4 inch in size illustrating material and finish of acoustical units.
- E. Samples: Submit two samples each, 12 inches long, of suspension system perimeter trim, perimeter trim, perimeter trim, and perimeter trim.
- F. Manufacturer's Installation Instructions: Indicate special procedures.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Extra Acoustical Units: Quantity equal to 5 percent of total installed.

1.06 QUALITY ASSURANCE

- A. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- B. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.07 FIELD CONDITIONS

- A. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Acoustic Panels Basis of Design:
 - 1. Armstrong World Industries, Inc: www.armstrong.com.
- B. Acceptable Manufacturers:
 - 1. Rockfon, LLC;[Rockfon Medical Plus]: www.rockfon.com..
 - 2. CertainTeed Corporation; Performa RX Symphony F: www.certainteed.com.

3. USG; Halcyon Healthcare Panels: www.usg.com.
- C. Suspension System Basis of Design:
 1. Armstrong World Industries, Inc[: www.armstrong.com
- D. Acceptable Manufacturers:
 1. Rockfon, LLC;[Chicago Metallic™ 1200 Seismic 15/16" Exposed]:
www.rockfon.com.
 2. CertainTeed Corporation; Seismic Secure Classic Stab Sysytem:
www.certainteed.com.
 3. USG; Donn Brand DX/DXL26 Acoustical Suspension System: www.usg.com.
 4. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 ACOUSTICAL TILE

- A. Glass Fiber Acoustical Panels: Vinyl faced glass fiberASTM E1264 Type XII with the following characteristics:
 1. Size: 24 by 24 inches.
 2. ASTM E 1264 Classification: Type XII; Form 2; Pattern E.
 3. Classification Performance per ASTM E 1264: Class A, Flame Spread 25 or less.
 4. Classification Performance per ASTM E 84: Smoke Developed 50 or less.
 5. Thickness: 3/4 inches.
 6. Light Reflectance: 90 percent, determined in accordance with ASTM E1264.
 7. NRC Rating: 0.95. determined in accordance with ASTM E1264.
 8. Ceiling Attenuation Class (CAC): 25, determined in accordance with ASTM E1264.
 9. Edge: Square.
 10. Surface Color: White.
 11. Washable Finish.
 12. Mildew Resistant.

2.03 SUSPENSION SYSTEM(S)

- A. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with stabilizer bars, clips, splices, perimeter moldings,

and hold down clips as required.

- B. Exposed Steel Suspension System: Formed steel, commercial quality cold rolled; heavy-duty.
 - 1. Profile: Tee; 15/16 inch wide face.
 - 2. Construction: Double web.
 - 3. Classification: Heavy Duty.
 - 4. Finish: White painted.

2.04 ACCESSORIES

- A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.
- B. Perimeter Moldings: Same material and finish as grid.
 - 1. At Exposed Grid: Provide L-shaped molding for mounting at same elevation as face of grid. 7/8 x 2 inch perimeter edge angle moldings as indicated on the Drawings.
- C. Decorative Perimeter Trim: Certainteed: Cloud Perimeter Trim;
<http://www.certainteed.com/ceilings>.
 - 1. Size: Refer to the Interior Design Drawings, Sheet I-600.
- D. Seismic Clips: 2 inch beam end retaining clip that joins main beam or cross tee to wall molding and web of grid with no visible pop rivets.
- E. Touch-up Paint: Type and color to match acoustical and grid units.

PART 3 EXECUTION

3.01 INSTALLATION - SUSPENSION SYSTEM

- A. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, ASTM C636/C636M, ASTM E580/E580M, ASTM C636/C636M, and ASTM E580/E580M and as supplemented in this section.
- B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
- C. Lay out system to a balanced grid design with edge units no less than 50 percent of acoustical unit size.
- D. Install after major above-ceiling work is complete. Coordinate the location of hangers with other work.

- E. Provide hanger clips during steel deck erection. Provide additional hangers and inserts as required.
- F. Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
- G. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
- H. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
- I. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.
- J. Do not eccentrically load system or induce rotation of runners.
- K. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
 - 1. Use longest practical lengths.
 - 2. Overlap and rivet corners.
- L. Form expansion joints as detailed. Form to accommodate plus or minus 1 inch movement. Maintain visual closure.

3.02 INSTALLATION - ACOUSTICAL TILE

- A. Install acoustical units in accordance with manufacturer's instructions.
- B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
- C. Fit border trim neatly against abutting surfaces.
- D. Install units after above-ceiling work is complete.
- E. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
- F. Cutting Acoustical Units:
 - 1. Cut to fit irregular grid and perimeter edge trim.
 - 2. Make field cut edges of same profile as factory edges.
 - 3. Double cut and field paint exposed reveal edges.
- G. Where round obstructions occur, provide preformed closures to match perimeter molding.

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- H. Install hold-down clips on each panel to retain panels tight to grid system; comply with fire rating requirements.
- I. Install hold-down clips on panels within 20 ft of an exterior door.

3.03 TOLERANCES

- A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.
- B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

END OF SECTION

**SECTION 09 65 00
RESILIENT FLOORING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Resilient sheet flooring.
- B. Installation accessories.

1.02 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 03 54 00 - Cast Underlayment.
- C. Section 09 05 61 - Common Work Results for Flooring Preparation: Independent agency testing of concrete slabs, removal of existing floor coverings, cleaning, and preparation.

1.03 REFERENCE STANDARDS

- A. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source 2019a, with Editorial Revision (2020).
- B. ASTM F1913 - Standard Specification for Vinyl Sheet Floor Covering Without Backing 2019.
- C. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source 2023.

1.04 SUBMITTALS

- A. See Section 01 33 00 - Shop Drawings, Product Data, and Samples, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
 - 1. Provide a comprehensive and complete list of proposed and other items specified, required, or otherwise necessary to complete the Work of this Section, including accessories and similar secondary items normally furnished, required or otherwise necessary for a complete installation.
 - 2. For accessories and other similar secondary items, submit a letter or affidavit from the manufacturer, printed on the manufacturer's company letterhead evidencing the selected accessories and secondary items are supplied, required, recommended, authorized, sanctioned, or accepted by the manufacturer for actual in-service conditions applicable to this Project.

- C. Shop Drawings: Indicate seaming plan, materials, colors and pattern layout, edge conditions: show the locations and extents of all items, accessories and trim, including seam locations; label each item with manufacturer's product name.
 - 1. Include medium scale (1/8 inch to 1/4 inch) scale plan drawings of each floor surface indicated as receiving floor covering.
 - 2. Show plan locations and sizes of all items, accessories and trim, including seam locations, openings, penetrations and other items installed in each surface.
 - 3. Show extents of each selected floor covering type, color, pattern, composition, grade, finish.
- D. Verification Samples: Submit two samples, 12 by 12 inch in size illustrating color and pattern for each resilient flooring product specified.
- E. Seam Samples: Submit two samples, 12 x 12 seam samples for each seamless installation specified, required, or otherwise necessary for every floor covering type, color, pattern with seam running lengthwise through center of each sample.
 - 1. Affix samples to rigid backing.
 - 2. Samples must be prepared by the same qualified installer that will perform the Work.
 - 3. Seam samples are intended as representative samples of actual finishes, colors and patterns.
- F. Certification: Prior to installation of flooring, submit written certification by flooring manufacturer and adhesive manufacturer that condition of sub-floor is acceptable.
- G. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Extra Flooring Material: 36 square feet of each type and color.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing work of the type specified and with at least five years of experience.
 - 1. Approved by flooring manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.

- B. Store all materials off of the floor in an acclimatized, weather-tight space.
- C. Maintain temperature in storage area between 55 degrees F and 90 degrees F.
- D. Protect roll materials from damage by storing on end.
- E. Do not double stack pallets.

1.07 FIELD CONDITIONS

- A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

PART 2 PRODUCTS

2.01 SHEET FLOORING

- A. Vinyl Sheet Flooring:
- B. Basis of Design:
 - 1. Nora: www.nora.com
- C. Products:
 - 1. Refer to Interior Design Drawings, Sheet I-600:
- D. Vinyl Sheet Flooring: Homogeneous without backing, with color and pattern throughout full thickness.
 - 1. Minimum Requirements: Comply with ASTM F1913.
 - 2. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E 648, NFPA 253, ASTM E 648, or NFPA 253.
 - 3. Thickness: 0.080 inch nominal.
 - 4. Seams: Heat welded.
 - 5. Integral coved base with cap strip.
 - 6. Pattern: As shown on drawings.
 - 7. Color: As indicated on drawings.
- E. Welding Rod: Solid bead in material compatible with flooring, produced by flooring manufacturer for heat welding seams, and in color matching field color.
- F. Welding Rod for Seamless Pattern matching non-solid colors for patterned flooring.: Manufacturer's stranded through-colored welding rods that match the color and design of the floor covering pattern.

1. Colors: As Selected by Architect.

2.02 RESILIENT BASE

A. Basis of Design:

1. Burke Flooring: www.burkemercer.com

B. Products:

1. Refer to Interior Design Drawings, Sheet I-600:

C. Acceptable Manufacturers:

1. Johnsonite, a Tarkett Company: www.johnsonite.com.
2. Mannington: <http://www.mannington.com/commercial>
3. Roppe Corp: www.roppe.com.

2.03 ACCESSORIES

- A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.
- B. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer.
- C. Moldings, Transition and Edge Strips: As indicated on the drawings.
- D. Filler for Coved Base: Plastic.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.
- C. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for resilient flooring installation by testing for moisture and pH.
 1. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.
- D. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

- A. Prepare floor substrates for installation of flooring in accordance with Section 09 05 61.

3.03 INSTALLATION - GENERAL

- A. Starting installation constitutes acceptance of sub-floor conditions.
- B. Install in accordance with manufacturer's written instructions.
- C. Spread only enough adhesive to permit installation of materials before initial set.
- D. Fit joints and butt seams tightly.
- E. Set flooring in place, press with heavy roller to attain full adhesion.
- F. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.
- G. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
- H. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.
- I. Install flooring in recessed floor access covers, maintaining floor pattern.

3.04 INSTALLATION - SHEET FLOORING

- A. Lay flooring with joints and seams parallel to longer room dimensions, to produce minimum number of seams. Lay out seams to avoid widths less than 1/3 of roll width; match patterns at seams.
- B. Seal seams by heat welding where indicated.
- C. Coved Base: Install as detailed on drawings, using coved base filler as backing at floor to wall junction. Extend sheet flooring vertically to height indicated, and cover top edge with metal cap strip.

3.05 INSTALLATION - RESILIENT BASE

- A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.
- B. Install base on solid backing. Bond tightly to wall and floor surfaces.

3.06 CLEANING

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean in accordance with manufacturer's written instructions.

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3.07 PROTECTION

- A. Prohibit traffic on resilient flooring for 48 hours after installation.

END OF SECTION

SECTION 09 67 00
FLUID-APPLIED FLOORING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fluid-applied flooring and base.

1.02 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 07 92 00 - Joint Sealants: Sealing joints between fluid-applied flooring and adjacent construction and fixtures.

1.03 SUBMITTALS

- A. See Section 01 33 00 - Shop Drawings, Product Data, and Samples, for submittal procedures.

1.04 MOCK-UP

- A. Construct mock-up(s) of fluid applied flooring to serve as basis for evaluation of texture and workmanship.
 - 1. Number of Mock-Ups to be Prepared: One.
 - 2. Use same materials and methods for use in the work.
 - 3. Locate where directed.
 - 4. Minimum Size: 48 inches by 48 inches.

PART 2 PRODUCTS

2.01 FLUID-APPLIED FLOORING SYSTEMS

- A. Resinous Flooring System
 - 1. Basis of Design: Stonehard: www.stonhard.com
 - a. Product: Stonshield HRI
 - b. System Thickness: 3/16"
 - c. Integral Cove Base
 - d. Color: As indicated on drawings.
 - 2. System Components: Manufacturer's standard components that are compatible with each other and as follows:

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- a. Primer:
 - 1) Material Basis: Stonhard Standard Primer
 - 2) Resin: Epoxy
 - 3) Formulation Description: (2) two component, 100 percent solids.
 - 4) Application Method: Squeegee and roller.
 - 5) Number of Coats: (1) one.
- b. Mortar Base:
 - 1) Material design basis: Stonshield HRI Base
 - 2) Resin: Epoxy.
 - 3) Formulation Description: (3) three component, 100 percent solids.
 - 4) Application Method: Metal Trowel.
 - (a) Thickness of Coats: nominal 1/8" (inch).
 - (b) Number of Coats: One.
 - 5) Aggregates: Pigmented Blended aggregate.
- c. Undercoat:
 - 1) Material Basis: Stonshield undercoat.
 - 2) Resin: Epoxy
 - 3) Formulation Description: (2) two-component, 100% solids, UV Stable.
 - 4) Type: Clear.
 - 5) Finish: Gloss.
 - 6) Number of Coats: one.
- d. Broadcast Media:
 - 1) Material Basis: Stonshield quartz aggregate
 - 2) Type: pigmented.
 - 3) Finish: standard.
 - 4) Number of Coats: one.
 - 5) Pattern: Tweed.

- e. Sealer:
- 1) Material Basis: Stonkote CE4.
 - 2) Resin: Epoxy
 - 3) Formulation Description: (2) two-component, 100% solids, UV Stable.
 - 4) Type: Clear.
 - 5) Finish: Gloss.
 - 6) Number of Coats: one.
 - 7) Texture level: Standard or medium.
- f. System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested according to test methods indicated:
- 1) Compressive Strength: 10,000 psi after 7 days per ASTM C579
 - 2) Tensile Strength: 2,000 psi per ASTM C307
 - 3) Flexural Strength: 4,300 psi per ASTM C580
 - 4) Flexural Modulus of Elasticity: 2.0×10^6 psi per ASTM C580
 - 5) Hardness: 85 to 90 per ASTM D2240, Shore D
 - 6) Impact Resistance: > 160 in./lbs. per ASTM D2794
 - 7) Abrasion Resistance: 0.06 gm max. weight loss per ASTM D 4060, CS-17
 - 8) Flammability: Class 1 per ASTM E-648.
 - 9) Thermal Coefficient of Linear Expansion: 1.3×10^{-5} in./in. oF
 - 10) Water Absorption: 0.1% per ASTM C 413
 - 11) VOC Content per ASTM D2369:
 - 12) Stonshield HRI Base – 40 g/l
 - (a) Stonshield Undercoat – 34 g/l
 - (b) Stonkote CE4 – 34 g/l
 - 13) Cure Rate @ 77oF/25oC: 12 hours foot traffic, 24 hours normal operations

2.02 ACCESSORIES

- A. Base Caps: See 09 30 50 - Tile Setting Materials and Accessories
- B. Patching, Leveling and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated.
- C. Joint Sealant: Type recommended or produced by resinous flooring manufacturer for type of service and joint condition indicated. Allowances should be included for Stonflex MP7 joint fill material.

PART 3 EXECUTION

3.01 INSTALLATION - FLOORING

- A. Apply in accordance with manufacturer's instructions.
- B. Finish to smooth level surface.

END OF SECTION

SECTION 09 91 23
INTERIOR PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints, stains, and varnishes.
- C. Scope: Finish interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.
 - 1. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
- D. Do Not Paint or Finish the Following Items:
 - 1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
 - 2. Items indicated to receive other finishes.
 - 3. Items indicated to remain unfinished.
 - 4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
 - 5. Stainless steel, anodized aluminum, bronze, terne coated stainless steel, and lead items.
 - 6. Marble, granite, slate, and other natural stones.
 - 7. Floors, unless specifically indicated.
 - 8. Ceramic and other tiles.
 - 9. Glass.
 - 10. Acoustical materials, unless specifically indicated.
 - 11. Concealed pipes, ducts, and conduits.

1.02 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.

1.03 DEFINITIONS

- A. Conform to ASTM D16 for interpretation of terms used in this section.

1.04 REFERENCE STANDARDS

- A. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications 2019.
- B. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials 2020.
- C. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual Current Edition.
- D. SSPC-SP 1 - Solvent Cleaning 2015, with Editorial Revision (2016).
- E. SSPC-SP 2 - Hand Tool Cleaning 2018.
- F. SSPC-SP 6 - Commercial Blast Cleaning 2007.

1.05 SUBMITTALS

- A. See Section 01 33 00 - Shop Drawings, Product Data, and Samples, for submittal procedures.
- B. Product Data: Provide complete list of products to be used, with the following information for each:
 - 1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
 - 2. MPI product number (e.g. MPI #47).
 - 3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
- C. Samples: Submit two paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
 - 1. Where sheen is specified, submit samples in only that sheen.
 - 2. Where sheen is not specified, discuss sheen options with Architect before preparing samples, to eliminate sheens definitely not required.
- D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Extra Paint and Finish Materials: 1 gallon of each color; from the same product run, store where directed.
 - 2. Label each container with color in addition to the manufacturer's label.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.07 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Minimum Application Temperatures for Paints: 50 degrees F for interiors unless required otherwise by manufacturer's instructions.
- D. Minimum Application Temperature for Varnish Finishes: 65 degrees F for interior, unless required otherwise by manufacturer's instructions.
- E. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Provide paints and finishes used in any individual system from the same manufacturer; no exceptions.
- B. Paints:
 - 1. Dunn Edwards Paint: <https://www.dunnedwards.com/>
 - 2. PPG Paints: www.ppgpaints.com/#sle.
 - 3. Sherwin-Williams Company: www.sherwin-williams.com/#sle.
 - 4. Benjamin Moore Paint.

2.02 PAINTS AND FINISHES - GENERAL

- A. Paints and Finishes: Ready mixed, unless intended to be a field-catalyzed paint.
 - 1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
 - 2. Provide 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.

3. For opaque finishes, tint each coat including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color.
 4. Supply each paint material in quantity required to complete entire project's work from a single production run.
 5. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.
- B. Volatile Organic Compound (VOC) Content: Comply with Section 01 61 16.
- C. Flammability: Comply with applicable code for surface burning characteristics.
- D. Sheens: Provide the sheens as indicated on drawings; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.
- E. Colors: As indicated on drawings.

2.03 PAINT SYSTEMS - INTERIOR

- A. Paint I-OP - Interior Surfaces to be Painted, Unless Otherwise Indicated: Including gypsum board, plaster, uncoated steel, shop primed steel, and galvanized steel.
1. Two top coats and one coat primer.
 2. Top Coat(s): Institutional Low Odor/VOC Interior Latex; MPI #143, 144, 145, 146, 147, or 148.
 3. Primer: As recommended by top coat manufacturer for specific substrate.

2.04 PRIMERS

- A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.
1. Interior Institutional Low Odor/VOC Primer Sealer; MPI #149.

2.05 ACCESSORY MATERIALS

- A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.
- B. Patching Material: Latex filler.
- C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin application of paints and finishes until substrates have been properly prepared.
- B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.
- D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- E. Test shop-applied primer for compatibility with subsequent cover materials.
- F. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
 - 1. Gypsum Wallboard: 12 percent.
 - 2. Plaster and Stucco: 12 percent.
 - 3. Masonry, Concrete, and Concrete Masonry Units : 12 percent.
 - 4. Interior Wood: 15 percent, measured in accordance with ASTM D4442.

3.02 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
- D. Seal surfaces that might cause bleed through or staining of topcoat.
- E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- F. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.
- G. Plaster: Fill hairline cracks, small holes, and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.
- H. Galvanized Surfaces:

1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
 2. Prepare surface according to SSPC-SP 2.
- I. Ferrous Metal:
1. Solvent clean according to SSPC-SP 1.
 2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
 3. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 "Commercial Blast Cleaning". Protect from corrosion until coated.
- J. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

3.03 APPLICATION

- A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
- B. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".
- C. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- D. Apply each coat to uniform appearance in thicknesses specified by manufacturer.
- E. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply as many coats as necessary for complete hide.
- F. Sand wood and metal surfaces lightly between coats to achieve required finish.
- G. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- H. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for general requirements for field inspection.

3.05 CLEANING

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.06 PROTECTION

- A. Protect finishes until completion of project.
- B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION

**SECTION 10 14 00
SIGNAGE**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Cash allowance for signs.
- B. Room and door signs.
- C. Emergency evacuation maps.

1.02 PRICE AND PAYMENT PROCEDURES

- A. Allowance amount covers purchase and delivery but not installation.

1.03 REFERENCE STANDARDS

- A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines current edition.
- B. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.
- C. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.
- D. CBC - California Building Code, Title 24, Part 2; 2013 Edition.

1.04 SUBMITTALS

- A. See Section 01 33 00 - Shop Drawings, Product Data, and Samples, for submittal procedures.
- B. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign.
- C. Signage Schedule: Provide information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
 - 1. When room numbers to appear on signs differ from those on drawings, include the drawing room number on schedule.
 - 2. When content of signs is indicated to be determined later, request such information from Owner through Architect at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.
 - 3. Submit for approval by Owner through Architect prior to fabrication.

- D. Verification Samples: Submit samples showing colors specified.
- E. Manufacturer's Installation Instructions: Include installation templates and attachment devices.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Curved Sign Media Suction Cups: One for each 100 signs; for removing media.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum ten years of experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Package signs as required to prevent damage before installation.
- B. Package room and door signs in sequential order of installation, labeled by floor or building.
- C. Store tape adhesive at normal room temperature.

1.07 FIELD CONDITIONS

- A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.
- B. Maintain this minimum temperature during and after installation of signs.

PART 2 PRODUCTS

2.01 SIGNAGE APPLICATIONS

- A. Accessibility Compliance: Signs are required to comply with ADA Standards and ICC A117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.
- B. Room and Door Signs: Provide a sign for every doorway, whether it has a door or not, not including corridors, lobbies, and similar open areas.
 - 1. Sign Type: Flat signs with engraved panel media as specified.
 - 2. Provide "tactile" signage, with letters raised minimum 1/32 inch and Grade II braille.
 - 3. Character Height: 1 inch.

4. Sign Height: 2 inches, unless otherwise indicated.
 5. Service Rooms: Identify with room names and numbers to be determined later, not those indicated on drawings.
 6. Rest Rooms: Identify with pictograms, the names "MEN" and "WOMEN", room numbers to be determined later, and braille.
- C. Emergency Evacuation Maps:
1. Allow for one map per elevator lobby.

2.02 SIGN TYPES

- A. Flat Signs: Signage media without frame.
1. Edges: Square.
 2. Corners: Square.
 3. Clear Cover: For customer produced sign media, provide clear cover of polycarbonate plastic, glossy on back, non-glare on front.
 4. Wall Mounting of One-Sided Signs: Tape adhesive.
 5. Wall and Ceiling Mounting of Two-Sided Signs: Aluminum wall bracket, powder coated, color selected from manufacturer's standard colors, attached with screws in predrilled mounting holes, set in clear silicone sealant.
- B. Radius / Curved Signs: One-piece, curved extruded aluminum media holder securing flat, flexible sign media by curved lip on two sides; other two sides closed by end caps; concealed mounting attachment.
1. Sizes: As indicated on drawings.
 2. Finish: Natural (clear) anodized.
 3. Sign Orientation: Curved in horizontal section.
 4. Wall Mounting of One-Sided Signs: Mechanical anchorage, with predrilled holes, and set in clear silicone sealant.
- C. Color and Font: Unless otherwise indicated:
1. Character Font: Helvetica, Arial, or other sans serif font.
 2. Character Case: Upper case only.
 3. Background Color: Clear.
 4. Character Color: Contrasting color.

2.03 TACTILE SIGNAGE MEDIA

- A. Engraved Panels: Laminated colored plastic; engraved through face to expose core as background color:

- 1. Total Thickness: 1/16 inch.

2.04 ACCESSORIES

- A. Concealed Screws: Stainless steel, galvanized steel, chrome plated, or other non-corroding metal.
- B. Tape Adhesive: Double sided tape, permanent adhesive.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install neatly, with horizontal edges level.
- C. Locate signs and mount at heights indicated on drawings and in accordance with ADA Standards and ICC A117.1.
- D. Protect from damage until Substantial Completion; repair or replace damaged items.

END OF SECTION

**SECTION 10 26 01
WALL AND CORNER GUARDS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Corner guards.

1.02 SUBMITTALS

- A. See Section 01 33 00 - Shop Drawings, Product Data, and Samples, for submittal procedures.
- B. Product Data: Indicate physical dimensions.
- C. Samples: Submit two sections of bumper rail, 24 inch long, illustrating component design, configuration, color and finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Corner Guards:
 - 1. Basis of Design:
 - a. Inpro; [Aluminum Surface Mount Corner Guard]: www.inprocorp.com.
- B. Acceptable Manufacturers:
 - 1. Construction Specialties, Inc; [_____]: www.c-sgroup.com/#sle.

2.02 COMPONENTS

- A. Products: Refer to Interior Design Drawings; Sheet I-600.
- B. Corner Guards - Surface Mounted:
 - 1. Performance: Resist lateral impact force of 100 lbs at any point without damage or permanent set.
 - 2. Surface Burning Characteristics: Provide assemblies with flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
 - 3. Width of Wings: 3.5".
 - 4. Corner: Square.
 - 5. Color: Refer to Interior Design Drawings; Sheet I-600..

- 6. Length: One piece.
- 7. Preformed end caps.

2.03 FABRICATION

- A. Fabricate components with tight joints, corners and seams.
- B. Pre-drill holes for attachment.
- C. Form end trim closure by capping and finishing smooth.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that rough openings, concealed blocking, and anchors are correctly sized and located.
- B. Verify that field measurements are as indicated on drawings.

3.02 INSTALLATION

- A. Install components in accordance with manufacturer's instructions, level and plumb, secured rigidly in position to wall framing members only.
- B. Position corner guard flush with top of wall base.
- C. Terminate rails 2 inches short of door opening.

3.03 TOLERANCES

- A. Maximum Variation From Required Height: 1/4 inch.
- B. Maximum Variation From Level or Plane For Visible Length: 1/4 inch.

END OF SECTION

SECTION 10 28 00
TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Commercial toilet accessories.
- B. Commercial shower and bath accessories.

1.02 RELATED REQUIREMENTS

- A. Section 08 83 00 - Mirrors: Other mirrors.
- B. Section 09 30 00 - Tiling: Ceramic washroom accessories.
- C. Section 22 40 00 - Plumbing Fixtures: Under-lavatory pipe and supply covers.

1.03 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.
- B. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service 2015a (Reapproved 2019).
- C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2015.
- D. ASTM C1036 - Standard Specification for Flat Glass 2021.
- E. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror 2018.

1.04 SUBMITTALS

- A. See Section 01 33 00 - Shop Drawings, Product Data, and Samples, for submittal procedures.
- B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
- B. Keys: Provide 2 keys for each accessory to Owner; master key lockable accessories.

- C. Stainless Steel Sheet: ASTM A666, Type 304.
- D. Stainless Steel Tubing: ASTM A269/A269M, Grade TP304 or TP316.
- E. Mirror Glass: Annealed float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.

2.02 FINISHES

- A. Stainless Steel: Satin finish, unless otherwise noted.

2.03 COMMERCIAL TOILET ACCESSORIES

- A. Toilet Paper Dispenser: Surface Mounted. Tork 56-TR, as indicated on drawings.
- B. Towel Dispenser: Surface mounted, Tork Peak Mini, 552538, as indicated on drawings
- C. Automated Soap Dispenser: Liquid soap dispenser, wall-mounted, Ecolab 9202-3093, as indicated on drawings.
- D. Mirrors: Stainless steel framed, 1/4 inch thick annealed float glass; ASTM C1036.
 - 1. Annealed Float Glass: Silvering, protective and physical characteristics in compliance with ASTM C1503.
 - 2. Bobrick B-165, as indicated on drawings
 - 3. Size per application.
- E. Seat Cover Dispenser: Surface mounted, Tork Smoke 1951001, as indicated on drawings.
- F. Grab Bars: Stainless steel, 1-1/4 inches outside diameter, minimum 0.05 inch wall thickness, nonslip grasping surface finish, concealed flange mounting; 1-1/2 inches clearance between wall and inside of grab bar.
 - 1. Length and configuration: As indicated on drawings.
- G. Combination Sanitary Napkin/Tampon Dispenser: Stainless steel, surface-mounted. Bobrick B-270, as indicated on drawings.

2.04 COMMERCIAL SHOWER AND BATH ACCESSORIES

- A. Shower Curtain Rod:
 - 1. Bobrick B-6047, as indicated on drawings.
- B. Shower Curtain:
 - 1. Material: White Vynil, Anti fungicide, flameproof, waterproof, low toxic.
 - 2. Product: Grainger 4EE Series

- 3. Grommets: Aluminum
- 4. Shower Curtain Hooks: Chrome-plated or stainless steel spring wire designed for snap closure.
- C. Folding Shower Seat: Wall-mounted surface; welded tubular seat frame, structural support members, swing-down legs, hinges, and mechanical fasteners of Type 304 stainless steel, L-shaped, right hand seat.
 - 1. Size: ADA Standards compliant.
- D. Towel Bar: Stainless steel, 3/4 inch square tubular bar; rectangular brackets, concealed attachment, satin finish.
- E. Robe Hook: Heavy-duty stainless steel, single-prong, rectangular-shaped bracket and backplate for concealed attachment, satin finish.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.
- B. Install plumb and level, securely and rigidly anchored to substrate.
- C. Mounting Heights: As required by accessibility regulations, unless otherwise indicated.
- D. Mounting Heights and Locations: As required by accessibility regulations, as indicated on drawings, and as follows:

END OF SECTION

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**SECTION 10 51 29
PHENOLIC LOCKERS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Phenolic lockers.
- B. Locker benches.

1.02 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.
- B. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.

1.03 SUBMITTALS

- A. See Section 01 33 00 - Shop Drawings, Product Data, and Samples, for submittal procedures.
- B. Product Data: Manufacturer's published data on locker construction, sizes and accessories.
- C. Shop Drawings: Indicate locker plan layout, [_____].
- D. Samples: Submit two samples [] by [] inches in size, of each color scheduled.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Protect locker finish and adjacent surfaces from damage.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Phenolic Lockers - Basis of Design:
 - 1. Spectrum Lockers: www.spectrumlockers.com.

2.02 LOCKER APPLICATIONS

- A. Wardrobe Lockers: Phenolic lockers, free-standing with matching closed base.
 - 1. Width: 12 inches.
 - 2. Depth: 18 inches.
 - 3. Height: 72 inches.
 - 4. Locker Configuration: Three tier.

5. Locking: Built-in digital keypad locks.
6. Provide sloped top.
- B. Locker Benches: Stationary type; bench top of phenolic material;
 1. Accessibility: Comply with ICC A117.1 and ADA Standards.
 2. Depth: 20 inch.
 3. Length: 48 inch.

2.03 PHENOLIC LOCKERS

- A. Lockers: Factory assembled, made of phenolic core panels with mortise and tenon joints and stainless steel mechanical joint fasteners; fully finished inside and out; each locker capable of standing alone.
 1. Doors: Full overlay, covering full width and height of locker body; square edges.
 2. Panel Core Exposed at Edges: Machine polished, without chips or tool marks; square edge unless otherwise indicated.
 3. Where locker ends or sides are exposed, finish the same as fronts or provide extra panels to match fronts.
 4. Door Color: As selected by Architect; allow for 2 different colors.
 5. Body Color: Manufacturer's standard white or light color.
 6. Fasteners for Accessories and Locking Mechanisms: Tamperproof type.
- B. Component Thicknesses:
 1. Doors: 1/2 inch minimum thickness.
 2. Locker Body: One of the following combinations:
- C. Phenolic Core Panels: Nonporous phenolic resin and paper core formed under high pressure, with natural colored finished edges, integral melamine surface, matte finish, and uniform surface appearance; glued laminated panels not acceptable.
- D. Number Plates: Manufacturer's standard, minimum 4-digit, permanently attached with adhesive; may be field installed.
- E. Locks: Locker manufacturer's standard type indicated above.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that prepared bases are in correct position and configuration.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install lockers plumb and square.
- C. Secure lockers with anchor devices to suit substrate materials. Minimum Pullout Force: 100 pounds.
- D. Bolt adjoining locker units together to provide rigid installation.
- E. Install end panels, filler panels, and sloped tops.
- F. Install accessories.
- G. Replace components that do not operate smoothly.

3.03 CLEANING

- A. Clean locker interiors and exterior surfaces.

END OF SECTION

**SECTION 12 36 00
COUNTERTOPS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Countertops for architectural cabinet work.
- B. Wall-hung counters and vanity tops.

1.02 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 06 41 00 - Architectural Wood Casework.
- C. Section 09 30 00 - Tiling: Tile for countertops.

1.03 REFERENCE STANDARDS

- A. ANSI A208.2 - American National Standard for Medium Density Fiberboard for Interior Use 2009.
- B. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2015.
- C. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.1 2016, with Errata (2017).
- D. IAPMO Z124 - Plastic Plumbing Fixtures 2022.
- E. ISFA 2-01 - Classification and Standards for Solid Surfacing Material 2013.
- F. ISFA 3-01 - Classification and Standards for Quartz Surfacing Material 2013.
- G. MIA (DSDM) - Dimensional Stone Design Manual, Version VIII 2016.
- H. NEMA LD 3 - High-Pressure Decorative Laminates 2005.
- I. PS 1 - Structural Plywood 2009.
- J. WI (CCP) - Certified Compliance Program (CCP) Current Edition.
- K. WI (CSIP) - Certified Seismic Installation Program (CSIP) Current Edition.
- L. WI (MCP) - Monitored Compliance Program (MCP) Current Edition.

1.04 SUBMITTALS

- A. See Section 01 33 00 - Shop Drawings, Product Data, and Samples, for submittal procedures.

- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Specimen warranty.
- C. Shop Drawings: Complete details of materials and installation ; combine with shop drawings of cabinets and casework specified in other sections.
 - 1. Provide the information required by AWMAC/WI (NAAWS).
 - 2. Include certification program label.
 - 3. Provide schedule indicating countertop identification symbols and locations.
 - 4. Use same reference numbers and details as the Drawings.
 - 5. Furnish elevations, sections and details showing standard construction and fabrication methods. Indicate materials, construction and finish.
- D. Verification Samples: For each finish product specified, minimum size 6 inches square, representing actual product, color, and patterns.
- E. Certificate: Submit labels and certificates required by quality assurance and quality control programs.
- F. Maintenance Data: Manufacturer's instructions and recommendations for maintenance and repair of countertop surfaces.

1.05 QUALITY ASSURANCE

- A. Quality Certification:
 - 1. Comply with WI (CCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section:
www.woodworkinstitute.com/#sle.
 - 2. Comply with WI (MCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section.
 - 3. For projects under OSHPD-1, OSHPD-2, or DSA jurisdiction, comply with WI (CSIP) woodwork association quality certification service/program in accordance with requirements for work specified in this section.
 - 4. Provide labels or certificates indicating that the installed work complies with AWMAC/WI (NAAWS) requirements for grade or grades specified.
 - 5. Provide designated labels on shop drawings as required by certification program.

6. Provide designated labels on installed products as required by certification program.
 7. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.
- B. Source Limitations: Obtain each type of countertops and accessories through one source from a single fabricator.
- C. Coordination:
1. Coordinate fabrication and installation with the work of related trades to ensure that supporting construction conforms to fabricator's tolerance requirements and that necessary rough-in work, backing and anchorage are properly installed.
- D. Sequencing:
1. Deliver countertops to the Project site only after the building has been enclosed with permanent exterior enclosure, and;
 - a. Wet work in storage areas, including but not limited to concrete, plastering, gypsum board finishing, tiling, painting and similar work has been completed and cured or dried to a condition of equilibrium.
 - b. Storage areas have been broom cleaned.
 - c. HVAC system has been activated, operating and maintaining temperature and relative humidity.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Packaging Requirements:
1. Store products in manufacturer's unopened packaging until ready for installation.
 2. Mark each item with identification number in distribution and installation.
- B. Delivery Requirements.
1. Deliver items to Project site in accordance with fabricator requirements or recommendations.
 2. During transport and delivery, protect items from prolonged exposure to UV radiation in excess of fabricator's recommendations. Protect from exposure to weather and or becoming wet or other forms of deterioration or damage.
- C. Acceptance at Site Requirements:
1. Inspect items for damage.
 2. Reject delivery of items that show damage or have damaged containers.

3. Unload and store only undamaged items.
- D. Storage and Handling Requirements:
1. Protect units from moisture damage.
 2. Store countertops in assigned spaces having controlled temperature and relative humidity conforming to the recommendations of WI.
 3. Handle countertops with clean hands.
- E. Waste Management:
1. Remove and dispose of construction waste at a disposal location away from Project site.
 2. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.07 FIELD CONDITIONS

- A. Existing Conditions:
1. Field verify measurements before preparing submittals and indicate those dimensions on the shop drawings.
 2. If field measurements cannot be made without delaying the Work, establish working dimensions that accommodate installation tolerances, as well as related tolerances specified in the Work of other Sections. Indicate those working dimensions on the shop drawings.
 3. Coordinate the installation of the adjacent work to ensure the actual dimensions accommodate the previously established working dimensions.
 4. Provide enough additional material during fabrication to allow for proper trimming and fitting at the Project site.
- B. During and after installation of architectural wood casework, maintain temperature and relative humidity conditions in building spaces at same levels planned for occupancy.
- C. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.
- D. Acclimate casework to specified temperature and relative humidity conditions for at least 72 hours before installation.

PART 2 PRODUCTS

2.01 COUNTERTOPS

- A. Quality Standard: Premium Grade, in accordance with AWMAC/WI (NAAWS), unless noted otherwise.
- B. Solid Surfacing Countertops: Solid surfacing sheet or plastic resin casting self-supporting over structural members.
 - 1. Basis of Design: Wilsonart, as indicated on drawings.
 - 2. Flat Sheet Thickness: 1/2 inch, minimum.
 - 3. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA 2-01 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
 - a. Manufacturers:
 - 1) Avonite Surfaces; Surfaces or Studio Collections: www.avonitesurfaces.com.
 - 2) Dupont; Corian: www.corian.com.
 - 3) Formica Corporation; Solid Surfacing: www.formica.com.
 - 4) Wilsonart; Solid Surface Collection: www.wilsonart.com.
 - b. NSF approved for food contact.
 - c. Sinks and Bowls: Integral castings; minimum 3/4 inch wall thickness; comply with IAPMO Z124.
 - d. Finish on Exposed Surfaces: Matte, gloss rating of 5 to 20.
 - e. Color and Pattern: As indicated on drawings.
 - 4. Other Components Thickness: 1/2 inch, minimum.
 - 5. Exposed Edge Treatment: Built up to minimum 1 1/2 inch thick; square edge.
 - 6. Back and End Splashes: Same sheet material, square top; minimum 4 inches high.
 - 7. Skirts: As indicated on drawings.

2.02 MATERIALS

- A. Wood-Based Components:

UC DAVIS MEDICAL CENTER
DT1 #1745B CATH LAB REPLACE X-RAY EQUIPMENT
PROJECT NO. 9557230

1. Wood fabricated from old growth timber is not permitted.
2. Provide sustainably harvested wood, certified or labeled as specified in Section 01 60 00 - Product Requirements.
- B. Plywood for Supporting Substrate: PS 1 Exterior Grade, A-C veneer grade, minimum 5-ply; minimum 3/4 inch thick; join lengths using metal splines. Provide at all sink locations.
- C. Medium Density Fiberboard for Supporting Substrate: ANSI A208.2.
- D. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.
- E. Cove Molding for Top of Splashes: Rubber with semi-gloss finish and T-spline to fit between splash and wall; 1/2 inch by 1/2 inch.
 1. Color: As indicated on drawings.
- F. Joint Sealant: Mildew-resistant silicone sealant, clear.
- G. Grommets: Standard plastic grommets for cut-outs, in color to blend with adjacent surface.
 1. Plastic Grommets:
 - a. Doug Mockett & Company, Inc.; EDP Flip-Top Series: www.mockett.com.
 - b. HefeLe; 631.26 Cable Grommet; www.hefele.com.
 - c. Or equal.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
 2. Style: Round with matching, removable cap.
 3. Size: 2 1/2 inch diameter.
 4. Provide 1 grommet for each 36" of worksurface unless otherwise indicated on the drawings. To be field located by Architect.
- H. Wall Mounted Counter Support Brackets:
 1. Manufacturers:
 - a. Rangine Corporation; RAKKS EH Series Counter Support Bracket: www.rakks.com.
 - b. Chemical Concepts; CounterBalance Concealed Bracket: www.counterbalanceshop.com.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.

2. Type: Inside-wall flush mounted.
3. Construction: Fabricated from horizontal aluminum T section and vertical aluminum L section. Vertical leg designed to attach to side of supporting stud and be concealed by gypsum board or other wall finish.
4. Size: As recommended by manufacturer for size of counter indicated on the drawings.
5. Load Capacity per bracket: 400 pounds.
6. Spacing and attachment: As recommended by the manufacturer for the size of counter indicated on the drawings. Provide equal and balanced spacing and coordinate locations with under-counter mounted components such as keyboard trays and cable management systems.
7. Backing: Coordinate stud locations or provide backing as indicated on the drawings.

I. Wall Mounted Vanity Support Brackets:

1. Manufacturers:
 - a. Rangine Corporation; RAKKS EHV Series Vanity Support Bracket: www.rakks.com.
 - b. Chemical Concepts; ADA Vanity Bracket: www.counterbalanceshop.com.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
2. Type: Surface mounted with ADA compliant panel supports.
3. Removeable Panels: Provide removeable panel to conceal piping. Match adjacent casework for panel construction and finish. Provide concealed mounting hardware where available. Where concealed mounting hardware not available from bracket manufacturer, provide Removeable Panel Dismountable Connectors.
4. Size: As recommended by manufacturer for size of vanity indicated on the drawings.
5. Load Capacity per bracket: 400 pounds.
6. Spacing and attachment: As recommended by the manufacturer for the size of counter indicated on the drawings. Provide equal and balanced spacing and coordinate locations with under-counter plumbing and components.
7. Backing: Coordinate stud locations or provide backing as indicated on the drawings.

2.03 FABRICATION

- A. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
 - 1. Join lengths of tops using best method recommended by manufacturer.
 - 2. Fabricate to overhang fronts and ends of cabinets 1 inch except where top butts against cabinet or wall.
 - 3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.
- B. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.
 - 1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
 - 2. Height: 4 inches, unless otherwise indicated.
- C. Solid Surfacing: Fabricate tops and wall panels up to 144 inches long in one piece; join pieces with adhesive sealant in accordance with manufacturer's recommendations and instructions.
- D. Wall-Mounted Counters: Provide skirts, aprons, brackets, and braces as indicated on Drawings; .

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify adequacy of backing and support framing.
- B. Coordinate requirements for stud spacing, backing, and auxiliary structural supports to ensure adequate means for installation and anchorage of support brackets.
- C. Do not begin installation until substrates have been properly prepared.
- D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- E. Verify that openings are properly framed, are true to line, plumb, square and within allowable tolerances.
- F. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.
- G. Reject work that does not conform to the manufacturer's installation requirements.
- H. Perform or arrange for required remedial work necessary to correct deficient conditions and to conform to fabricator's requirements.

3.02 COORDINATION

- A. Coordinate provision of support brackets with design and fabrication of counter tops, work surfaces, and benches to be supported to ensure compatibility of dimensions and load capacity.
- B. Coordinate installation of support brackets with other trades. Ensure that support brackets are delivered to site and installed in a timely manner.

3.03 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.04 INSTALLATION

- A. Securely attach countertops to cabinets or supports using concealed fasteners. Make flat surfaces level; shim where required.
- B. Seal joint between back/end splashes and vertical surfaces.
 - 1. Where indicated use rubber cove molding.
 - 2. Where applied cove molding is not indicated use specified sealant.

3.05 CLEANING

- A. Clean countertops surfaces thoroughly.
- B. Clean countertops, shelves, hardware, fittings, and fixtures as required, recommended, approved or accepted by the manufacturer.
- C. Do not use cleaning materials or procedures that could change the appearance of exposed finishes or damage adjacent materials.
- D. Waste Management; After completing the Work, leave work areas free from debris, materials, equipment, and related items.

3.06 PROTECTION

- A. Protect items in place from sources of moisture, corrosion, deterioration, staining or other damage.
- B. Do not use countertop surfaces as work surfaces.
- C. Protect installed products until completion of project.
- D. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

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SECTION 13 49 13
INTEGRATED X-RAY SHIELDING ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Construction of lead enclosure for shielding of x-ray radiation.
 - 1. Lead-lined Gypsum Board
 - 2. Lead-lined Gypsum Board Accessories
 - 3. Lead-Lined Hollow Metal Frames
 - 4. Lead-Lined Hollow Metal Frame Accessories
 - 5. Lead-Lined Hollow Metal Doors
 - 6. Lead Sheet and Associated Materials

1.02 RELATED REQUIREMENTS

- A. Physicist Report as provided on the drawings.
- B. Section 08 11 13 - Hollow Metal Doors and Frames: Fabrication, Finishing, Delivery Storage and Handling
- C. Section 08 71 00 - Door Hardware: Lead-lined door hardware.
- D. Section 09 21 16 - Gypsum Board Assemblies: Finishing, Delivery Storage and Handling
- E. Section 09 91 23 - Interior Painting: Field painting.

1.03 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM A 109 - Standard Specification for Steel, Strip, Carbon (0.25 Maximum Percent), Cold-Rolled.
 - 2. ASTM A 415 - Standard Specification for Hot-Rolled Carbon Steel Sheets, Commercial.
 - 3. ASTM B 29 - Standard Specification for Refined Lead.
 - 4. ASTM B749 - Standard Specification for Lead and Lead Alloy Strip, Sheet, and Plate Products 2014.
 - 5. ASTM C1002 - Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.

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6. ASTM C1036 - Standard Specification for Flat Glass 2021.
 7. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass 2018.
 8. ASTM C1396/C1396M - Standard Specification for Gypsum Board 2017.
 9. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber
 10. ASTM E 119 - Fire Tests of Building Construction and Materials.
- B. American National Standards Institute (ANSI):
1. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frame Anchors and Hardware Reinforcing.
 2. ANSI A250.8 (formerly SDI 100) - Recommended Specifications for Standard Steel Doors and Frames.
- C. California Code of Regulations (CCR)
1. Title 8 - CAL-OSHA Sec 1532.1, Sec 5198, and Sec 5216
 2. CCR Title 17 - California Radiation Control Regulations; latest edition
- D. Glass Association of North America (GANA)
1. Glazing Manual
- E. Gypsum Association (GA):
1. GA 201 - Gypsum Board for Walls and Ceilings.
 2. GA 216 - Recommended Specifications for the Application and Finishing of Gypsum Board.
- F. United States Nuclear Regulatory Commission
1. NRC 10 CFR 20 - United States Nuclear Regulatory Commission; latest edition.
- G. Steel Door Institute (SDI):
1. SDI 111 Series (111A-111F): Recommended Details, Steel Doors and Frames.
 2. SDI 117-93: Manufacturing Tolerances for Standard Steel Doors and Frames.
- H. U.S. Department of Labor Occupational Safety and Health Administration (OSHA):
1. OSHA standard 29 CFR 1910.1025 - Lead.
 2. OSHA standard 29 CFR 1926 - Safety and Health Regulations for Construction.

3. OSHA standard 29 CFR 1926.62 - Lead

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate this work with the construction of the building elements that x-ray protection is applied to or installed in.
- B. Preinstallation Meeting: Convene two weeks prior to commencing work of this section.

1.05 SUBMITTALS

- A. See Section 01 33 00 - Shop Drawings, Product Data, and Samples , for submittal procedures.
- B. Product Data: Product data, performance data, physical properties, and installation instructions for each item furnished hereunder. Include material characteristics, size limitations, and special application requirements.
- C. Certifications: Manufacturer's written certification stating that lead-lined gypsum board systems and all related items to be furnished hereunder, meet or exceed the requirements specified under this Section and are in compliance with Physicist of Record report(s), and that the applicator is qualified and approved to install the materials in accordance with manufacturer's product data.
- D. Shop drawings:
 - 1. Indicate layout, dimensions, and Manufacturer's standard design details of critical intersections within assemblies and complete installation details where shielding will interface with work of other sections.
 - 2. Show sufficient detail to show fabrication, installation, anchorage, and interface of the work of this Section with the work of adjacent trades.
 - 3. Show ducts, pipes, conduit, and other objects that penetrate radiation protection together with details of penetrations.
 - 4. 1/4 inch scale elevations and plans of each type of door and glazing assembly; Verify dimensions with field measurements.

1.06 QUALITY ASSURANCE

- A. Notify the Architect where conflicts apply between referenced standards and existing materials, and existing methods of construction.
- B. Take field measurements before preparation of shop drawings and fabrication, where possible, to ensure proper fitting of Work. Allow for adjustments within specified tolerances wherever taking of field measurements before fabrication.
- C. Coordinate the work of this Section with the respective trades responsible for installing interfacing work, and ensure that the work performed hereunder is acceptable to such trades for the installation of their work.

- D. Perform Work in accordance with GANA - Glazing Manual except as specifically recommended otherwise by glazing or framing manufacturer.
- E. Source Limitation: Obtain each type of radiation protection product through one source from a single manufacturer.
- F. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least three years documented experience.
- G. Installer Qualifications: Company specializing in performing work of the type specified and with at least ten years of.
 - 1. Foreman, job supervisors and installers:
 - a. Certified by manufacturer to have not less than five years of experience in the installation of radiation shielding.
 - b. Certified with not less than 10 hours of OSHA training in occupational safety and health.
 - c. Trained by, and approved by the product manufacturer.

1.07 REGULATORY REQUIREMENTS

- A. Conform to applicable health and occupation code for integrity of radiation protection and continuity of protected construction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. X-Ray Radiation Protection - Basis of Design:
 - 1. Ray-Bar Engineering Corp; www.raybar.com.
- B. Acceptable Manufacturers- Radiation Protection Materials and Equipment:
 - 1. Mayco Industries, Inc: www.maycoindustries.com.
 - 2. NELCO San Francisco: 1840 Williams Street, San Leandro, CA 94577, Phone: (800) 635-2613, www.nelcoworldwide.com
 - 3. A&L Shielding, Inc
 - 4. Bar-Ray Products, Inc
 - 5. AmRay Group
- C. Lead Lined Steel Door Frames:
 - 1. A&L Shielding, Inc

2. Pioneer Industries
 3. Precision Metals, Inc
 4. Security Metal Products, Inc
- D. Lead-Lined Wood Doors:
1. Algoma Hardwoods, Inc
 2. Eggers Industries, Architectural Door Div.
 3. Oshkosh Architectural Door Co.
 4. Weyerhaeuser Co.
- E. Substitutions: See Section 01 60 00 - Product Requirements.
- F. Lead-Laminated Gypsum Board:
1. Radiation Protection Products; Lead Lined Drywall: www.rppinc.com/#sle.

2.02 LEAD-LINED GYPSUM BOARD

- A. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place
1. Application: Use for vertical surfaces, unless otherwise indicated.
 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 3. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
 4. Thickness: 5/8 inch.
 5. Edges: Tapered.
- B. Ceiling Board: Special sag resistant gypsum ceiling board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
1. Application: Ceilings, unless otherwise indicated.
 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 3. Thickness: 5/8 inch.
 4. Edges: Tapered.
- C. Backing Board For Non-Wet Areas: Water-resistant gypsum backing board as defined in ASTM C1396/C1396M; sizes to minimum joints in place; ends square cut.
1. Application: Vertical surfaces behind thinset tile, except in wet areas.

2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 3. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
 4. Thickness: 5/8 inch.
 5. Edges: Tapered.
- D. Lead sheet: Conforming to ASTM B 29 in uniform thickness as required by Physicist of Record report(s).

2.03 LEAD-LINED GYPSUM BOARD ACCESSORIES

- A. Lead Batten Strips (Ribbon Lead): lead strips, free from any imperfections, conforming to ASTM B 29, having same thickness as lead lining on gypsum board. Provide 2 inch [50mm] wide lead strips for straight runs and 3-inch-wide lead strips at corners.
- B. Fastener Protection: Not required at lead thicknesses less than 1/16" (4 pounds) per NCRP 147. For lead thicknesses greater than 1/16" (4 pounds) or where specifically required by the physicist report, the following two options are acceptable.
 1. Lead Disc to meet shielding requirements, conforming to ASTM B 29, for installation over gypsum board fastener heads.
 2. Lead Tabs to meet shielding requirements, conforming to ASTM B 29, for installation over gypsum board fastener heads.
- C. Lead Lining at Electrical Boxes, Medical Gas Penetrations, and Similar Conditions: Shield with the same thickness as the lead walls. At fire or smoke rated walls also provide through-penetration fire sealant and Underwriter's Laboratory CLIV listed opening protectives.
- D. Fasteners:
 1. Type S-6 or greater fine thread rust resistant self-drilling screws complying with ASTM C 1002, not less than 1-1/4 inch length, for applying lead-lined gypsum board to light gage metal framing having thickness of 0.033 to 0.112 inch thick.
 2. Type W, bugle head screws complying with ASTM C 1002, not less than 1-1/4 inch length for applying lead-lined gypsum board to wood framing and furring.

2.04 LEAD-LINED HOLLOW METAL FRAMES

- A. General: Refer to the Drawings, Sheet(s) A-600 for various types of frames, sizes, and profiles, UL fire-resistive label frames, and other characteristics of frames and related items.
- B. Frame type: Shop welded frames with mitered joints arc-welded, reinforced and ground smooth.

- C. Materials for frames, reinforcement, anchors, anchor clips, and related items: commercial grade cold-rolled steel conforming to ASTM A109 or commercial grade hot-rolled and pickled steel conforming to ASTM A415.
1. Frame gage: 16 gage, 0.053 inch thick.
 2. Hinge, lock, and strike reinforcement: 7 gage thick.
 3. Door closer reinforcement: 12 gage, minimum 0.093 inch thick.
 4. Shop-fabricate frames as whole single units per opening, except when frame size is too large to ship as a single unit. Oversized frames may be shipped in large sections as practicable for field assembly with concealed splice plates or channels.
 5. Reinforcements, stiffeners, and base angle clips: Welded to interior surfaces of frames to provide a stable base and so as to not interfere with installation of hardware.
 6. Appearance of finished frames: Strong, rigid, completely free from warp and buckle, with miters well-formed and in true alignment, and with surfaces smooth and free from defects of any kind.
 7. Line frames with sheet lead conforming to ASTM B 29 in uniform thickness as required by Physicist of Record report(s). Install sheet lead free of waves, lumps, and wrinkles with as few joints as possible. Form and permanently adhere lead around and concealed behind the frame.
 8. Anchor clips for frames in metal stud partitions: 16-gage steel z-shaped clips, 1-1/2 inch upturned and downturned legs, or equivalent type standard with the manufacturer, contained within the frames, for screw attachment to metal studs.
 9. Provide not less than 3 anchors, clips, or bolts, per jamb, as applicable.

2.05 LEAD-LINED HOLLOW METAL FRAME ACCESSORIES

- A. Glazing Tape: Preformed butyl-polyisobutylene rubber with 100 percent solids contained in extruded tape roll form and complying with AAMA 804.1. Sizes as required for proper glazing.
- B. Sealants and Adhesives: approved by manufacturer for use with Lead Glazing, and complying with VOC requirements for this project.
- C. Setting blocks: Neoprene, 80-90 shore A durometer hardness, certified to be "silicone compatible."
- D. Spacers: : Neoprene, 60-80 shore A durometer hardness

2.06 LEAD-LINED HOLLOW METAL DOORS

- A. General: Refer to the Drawings, Sheet(s) A-600 for various types sizes, and profiles, UL fire-resistive labels, and other characteristics of doors and related items.
- B. Label: Clearly label lead thickness on hinge-side edge
- C. Hardware: At paired doors provide lead-lined astragal and coordinator in addition to other hardware as specified in 08 71 00 - Door Hardware.
- D. Materials for doors, reinforcement, and related items: commercial grade cold-rolled steel conforming to ASTM A109 or commercial grade hot-rolled and pickled steel conforming to ASTM A415.
 - 1. Face gage: 18 gage, minimum 0.043 inch thick.
 - 2. Edge reinforcement: 16 gage, minimum 0.053 inch thick channel continuous at door perimeter.
 - 3. Core: 1/2" cell honeycomb core
 - 4. Line doors with sheet lead conforming to ASTM B 29 in uniform thickness as required by Physicist of Record report(s). Install sheet lead free of waves, lumps, and wrinkles with as few joints as possible.
 - 5. Hinge reinforcement: 7 gage thick
 - 6. Lock reinforcement: 12 gage, minimum 0.093 inch thick
 - 7. Lock support: 20 gage, minimum 0.033 inch thick
 - 8. Door closer reinforcement: 14 gage, minimum 0.067 inch thick
 - 9. Other surface-mounted hardware: 16 gage, minimum 0.054 inch thick

2.07 LEAD SHEET AND ASSOCIATED MATERIALS

- A. Sheet Lead: ASTM B749, Type in weight(s) as recommended by the Physicist Reports for the Project. Refer to Specification 00 31 55 - Physicist Reports

2.08 FABRICATION

- A. Lead-lined Gypsum Board: Un-pierced lead permanently laminated to gypsum board in factory using manufacturer's recommended adhesive.
- B. Maximum variation for lead lined frames: Maximum diagonal distortion 1/16 inch measured with straight edge, corner to corner.
- C. Also comply with Section 08 11 13 - Hollow Metal Doors and Frames
- D. Also comply with Section 08 71 00 - Door Hardware

2.09 FINISHES

- A. General: Refer to the Drawings, Sheet(s) I-600 , for various finish types.
- B. Preparation: Pressure-sand all surfaces of all frames, accessory items, anchors, and related items, to remove blemishes and foreign matter and provide paint grip. Spot-fill imperfections with metallic filler and sand smooth. Thoroughly clean the surfaces by applying hot or cold phosphate treatment standard with the manufacturer.
- C. Following cleaning apply one dip or spray coat of rust-inhibitive metallic oxide, zinc chromate, or synthetic resin primer to all surfaces, including those which will be concealed after erection. Bake, or oven dry, the primer at time and temperature recommended by the manufacturer for developing maximum hardness and resistance to abrasion.
- D. Also comply with Section 08 11 13 - Hollow Metal Doors and Frames
- E. Also comply with Section 08 71 00 - Door Hardware
- F. Also comply with Section 09 21 16 - Gypsum Board Assemblies
- G. Also comply with Section 09 91 23 - Interior Painting

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that all items which are to be enclosed by Work of this Section have been permanently installed, inspected, and approved.
- B. Inspect framing and other substrates; verify that they are in proper condition to receive the work of this Section.
- C. Verify that opening sizes and tolerances are acceptable and in compliance with these specifications and applicable codes.
- D. Inspect glazing receiving surfaces and ensure that they are dry and free from dust, or other foreign materials before glazing. Clean all surfaces as recommended by glazing tape or glazing sealant manufacturer, before glazing.
- E. Check all openings, prior to glazing, to make certain that the opening is square, plumb and secure in order that uniform face and edge clearances are maintained.
- F. Beginning of installation means acceptance of existing conditions.

3.02 INSTALLATION OF LEAD-LINED GYPSUM BOARD

- A. Shield to be continuous up to a minimum height of 7 feet or as specified in the by Physicist of Record report(s).
- B. Prior to installation of lead-lined gypsum board:

1. Install 2-inch-wide lead battens at all vertical stud framing (and ceiling joists). At corner intersections of walls (and ceilings) provide 3-inch-wide battens or, if framing allows, corner lapping of lead-lined gypsum board.
 2. Install lead lining at all electrical outlet boxes, medical gas boxes, and similar penetrations occurring in gypsum board.
 3. Make provisions for connection with lead-lined doorframes and cutouts for vision panels.
 4. Install screw tabs on studs where required.
- C. Screw-fasten boards to framing and furring, with ends and edges occurring over firm bearing. Screw fasten lead-lined gypsum panels 8 inches on center at panel edges and 12 inches on center to intermediate framing members.
1. Erect all lead-lined gypsum board vertically on wall surfaces. Install boards horizontally where required by Code.
 2. Erect ceiling gypsum boards to meet UL requirements, where applicable, stagger end joints over supports. Secure gypsum board with fasteners inserted through ceiling buttons; anchor fasteners directly to framing or suspended support system.
 3. Recess gypsum board screws slightly into board surface and cap.
- D. Wherever items penetrate the gypsum board surfaces, use extra care in cutting the gypsum board to ensure a uniformly dimensioned joint between the penetrating item and the gypsum board. Verify the expected deflection factor of the penetrating members, and cut the gypsum accordingly, to prevent damage thereto from the deflecting members.

3.03 INSTALLATION OF FRAMES

- A. Pre-coordination for rough openings in framing.
- B. General: Install frames in accordance with the manufacturer's recommendations, and applicable parts of ANSI A250.8. Install with a maximum diagonal distortion of 1/16 inch measured with a straight edge, corner to corner.
- C. Place in position all steel frames, in accordance with the approved shop drawings and frame schedule.
1. Coordinate installation of frames with the various trades installing abutting wall construction for anchor placement and continuity of lead lining.
 2. Provide rigid temporary bracing for frames as required to ensure maintenance of positioning, and remove only after frames have been permanently anchored.
 3. Where exposed fastener heads occur in frames, fill with automotive body filler and sand smooth.

3.04 INSTALLATION OF SHEET LEAD

- A. Install lead sheets to wall substrate by mechanical attachments; lead headed fasteners spaced at 4 inches to framing members. Install lead laminated products with lead face against supports.
- B. Lap edges and ends of lead sheets 1 inch. Apply lead patches, same thickness as lead sheet, over penetrations, to achieve continuity of protection.
- C. Extend lead protection from finished floor to a height of 84 inches.
- D. Apply lead sheet patches around penetrations to sheet lead protection, extending 6 inches beyond penetration.

3.05 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Section 01 40 00 - Quality Requirements.
- B. Inspection and testing will be performed by a licensed radiologist technician in coordination with regulatory agency requirements, to ascertain conformance of installation regarding radiation passage or leakage.
- C. Maximum variation for gypsum board partitions and ceilings from true flatness: 1/8 inch per 10 feet noncumulative.
- D. Maximum variation from plumb or level for frames: 1/8 inch.
- E. Maximum offset from true dimensional alignment for frames: 1/8 inch.

3.06 SCHEDULES

- A. Install x-ray radiation protection as in locations as denoted on the Drawings as required by the Physicist Reports for the Project. Refer to Specification 00 31 55 - Physicist Reports.

END OF SECTION

SECTION 21 05 00

BASIC MATERIALS AND METHODS FOR WET PIPE SPRINKLER SYSTEMS

PART 1

GENERAL

1.1 SUMMARY

- A. Section includes: Minor modifications to wet pipe fire sprinkler systems to maintain complete area coverage, including
 - 1. Sprinkler heads
 - 2. Sprinkler piping materials

1.2 SUBMITTALS

- A. Submit product data, warranties, operating and maintenance data.
- B. Submit drawings, calculations and other supporting documents as required for review and approval by the Authority Having Jurisdiction.
 - 1. All drawings, calculations, and other supporting documents shall be prepared by, or under responsible charge of, an Architect, Structural Engineer, or Mechanical Engineer licensed to practice in California and shall include the signature and seal or stamp of the licensee.

1.3 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, the California Fire Code, and California Mechanical Code, IAPMO; the NFPA Pamphlet 13, 14, 24, 291; and other applicable laws or regulations.
- B. Where the standards of the drawings and specifications for materials and/or workmanship are higher than the requirements of the regulations cited above, the drawings and specifications shall take precedence; otherwise the documents shall govern.
- C. Provide materials and apparatus that bear the UL label where such label is applicable.
- D. Coordinate fire alarm system operation with Owner. Maintain coverage during construction, and coordinate any necessary disruptions.

1.4 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.

PART 2

PRODUCTS

2.1 PRODUCTS

- A. Provide piping per NFPA 13 and NFPA 14 codes suitable for the system and to match existing piping.
 - 1. Standard-Pressure, Wet-Pipe Sprinkler System, NPS 2 (DN 50) and Smaller:
 - a. Standard-weight, black-steel pipe with threaded ends and uncoated, gray-iron fittings.
- B. Sprinkler heads: Recessed, Semi-recessed, or exposed: Type and finish to match existing.

2.2 ACCEPTABLE MANUFACTURERS

- A. Sprinkler Heads and Accessories:
 - 1. Automatic Sprinkler
 - 2. Grinnell
 - 3. Reliable
 - 4. Viking
 - 5. Central

PART 3

EXECUTION

3.1 INSTALLATION

- A. Install piping per NFPA codes, state and local regulations, ordinances and requirements of authorities having jurisdiction.
- B. Modify, relocate and extend existing piping to accommodate new work:
 - 1. Relocate existing sprinkler heads as required to provide complete area coverage.
 - 2. Provide additional sprinkler heads as required to provide additional coverage. Provide hydraulic calculations in support of any change in flow.
 - 3. Provide sprinkler heads to match existing types in appearance, finish, and function.
- C. Coordinate location of sprinkler heads to avoid interference with locations of designated lighting fixtures and air outlets.

- D. Conceal piping to the greatest extent practical.
- E. Center ceiling mounted elements in center of ceiling tiles unless otherwise noted.
- F. Test piping systems for leaks per NFPA codes and verify alarms for proper operation.
- G. Instruct Owner's personnel in proper operation of the systems.

3.2 SPRINKLER HEADS

- A. Fusible Link Temperature Ratings:
 - 1. Select to suit specific hazard area in accordance with NFPA 13.
 - 2. Place sprinklers in upright or pendant position as required, with the deflector parallel to the ceiling.
- B. For suspended ceilings select standard, recessed or pendant type with brass or chrome-plated finish and escutcheon.
- C. For exposed areas select standard upright type with brass or chrome-plated finish and escutcheon.

END OF SECTION

SECTION 22 05 10
BASIC PLUMBING MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. The intent of Division 22, and 23 Specifications and Drawings is to provide complete and workable plumbing systems as shown, specified and required by applicable codes. Include all work specified in Division 22 and 23 and shown on the Drawings, including appurtenances, connections, demolition, appliances, and incidental accessories to make work complete and ready for operation.
- B. The Drawings that accompany the Division 22, and 23 Specifications are diagrammatic. They do not show every offset, pipe 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 22, and 23 work as required by Division 01.
- C. Include minor details not usually shown or specified, but necessary for proper installation and operation of a system or piece of equipment in work and in bid price, the same as if specified or shown.

1.3 ENFORCEABLE CODES

- A. The code publications listed below form a part of this specification. This list is not exclusive, local and other codes may also apply:
 - 1. 2019 California Administrative Code (CAC), Part 1, Title 24, California Code of Regulations (CCR).
 - 2. 2019 California Building Code (CBC), Part 2, Title 24, CCR, (Based on the 2018 International Building Code).
 - 3. 2019 California Electrical Code (CEC), Part 3, Title 23, CCR, (Based on the 2017 National Electrical Code).
 - 4. 2019 California Mechanical Code (CMC), Part 4, Title 24, CCR, (Based on the 2018 Uniform Mechanical Code).
 - 5. 2019 California Plumbing Code (CPC), Part 5, Title 24, CCR, (Based on the 2018 Uniform Plumbing Code).
 - 6. 2019 California Fire Code (CFC), Part 9, Title 24, CCR, (Based on the 2018 International Fire Code).

1.4 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subjected to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
 - 1. PE: Polyethylene plastic.
 - 2. PVC: Polyvinyl chloride plastic
- G. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber
 - 2. NBR: Acrylonitrile-butadiene rubber.

1.5 REFERENCES

- A. Publications and Standards listed below form a part of this specification to the extent referenced. The Publications and Standards are referenced 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.
 - 4. National Electrical Safety Code.
 - 5. National Electrical Testing Association.
 - 6. Underwriter's Laboratories, Inc. Standards.
 - 7. American National Standards Institute.
 - 8. American Society for Testing Materials Standards.

9. National Fire Protection Association Standards.
10. American Society of Mechanical Engineers Boiler and Pressure Vessel Codes.
11. American Water Works Association.
12. Occupational Safety and Health Act.
13. Uniform Mechanical and Plumbing Codes with applicable State of California amendments.
14. Commercial and Industrial Insulation Standards.
15. American Gas Association.
16. American Society of Heating, Refrigerating and Air-Conditioning Engineers.
17. Sheet Metal and Air conditioning Contractor's National Association Standards.
18. Air-Conditioning and Refrigeration Institute Standards.
19. American Welding Society.

1.6 SUBMITTALS

- A. Comply with requirements of Division 01.
- B. Coordination Drawings: Each trade shall be responsible for their own respective coordination drawing effort with the HVAC contractor being the coordination effort team leader. Drawings shall be electronic (AutoCAD) and each trade shall have the ability to coordinate electronically (xref) into each other's drawings for collision checking and spatial conditions. When coordination effort is completed contractors shall sign drawings demonstrating that they are buildable shop drawings. Coordination drawings can also be used as the contract "as-builts" at project completion.
- C. Submit required copies of shop drawings, product data, samples, schedules and reports as required by individual Division 21, 22, and 23 Sections.

1.7 QUALITY ASSURANCE

- A. Provide Work and materials in accordance with the latest rules and regulations of the California State Fire Marshal and the California State Department of Public Health, Titles 17 and 24; the California Plumbing Code and California Mechanical Code, IAPMO; the NFPA Pamphlet 13, 14, 24, 291; and other applicable laws or regulations.
- B. Where the standards of the drawing and specifications for materials and/or workmanship are higher than the requirements of the regulations cited above, the drawings and specifications shall take precedence; otherwise the regulations shall govern.
- C. Provide materials and apparatus that bear the UL label where such label is applicable.
- D. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code – Steel".

1.8 DELIVERY, STORAGE AND HANDLING

- A. Protect materials from corrosion and breakage. Store materials above grade. Provide appropriate covering.
- B. Replace any materials which are damaged or degraded by improper storage with new.

1.9 SITE VISITATION

- A. Visit the site prior to bidding and become familiar with existing conditions and other factors which may affect the execution of the work. Include all related cost in the initial bid proposal.

1.10 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08.
- D. Coordinate all equipment and piping layout with other trades.

1.11 WARRANTY

- A. Comply with the requirements of Division 01.
- B. Provide manufacturer's written warranties covering defects in materials and workmanship of products and equipment utilized for this project.
- C. Each complete system shall be warranted for a period of one year from the date of Substantial Completion.
- D. Each system shall be free of defects in materials and workmanship, and shall perform satisfactorily under all conditions of load or service.
- E. The warranties shall provide that all additional controls, protective devices, or equipment be provided as necessary for operation of the system or equipment.
- F. Replace or repair faulty materials or workmanship at no additional cost to the Owner.
- G. See specific sections for additional equipment warranty items.

1.12 OPERATING INSTRUCTIONS MANUALS

- A. Provide 2 copies of complete Manual, bound in booklet form, plus an electronic copy on permanent storage media. Each manual shall contain the following information:
 - 1. List of all equipment with manufacturer's name, model number, and local representative, service facilities, and the normal channel of supply for each item.

2. Manufacturer's literature describing each item of equipment with detailed parts list.
3. Equipment service schedules and IOMs.
4. Equipment Warranties.
5. Certificates of Inspection.
6. Record Drawings and related Shop Drawings.
7. Water System Balance Reports.

1.13 RECORD DRAWINGS

- A. Maintain at the site an up to date set of prints of Engineering Drawings which clearly indicate (by shading, coloring or some other acceptable method) the daily extent of Work installed.
- B. Indicate on Drawings changes in elevation, location, or size of material deviating from original design.
- C. Clearly indicate any dimension changes in elevation, location, size or material, and offsets for valves.
- D. Locate all underground, concealed or buried piping by two or more dimensions per turn of pipe between each direction change.
- E. Show all elevations (invert or centerline) with the point of elevation change clearly located.
- F. Number and letter valves to correspond with numbers and letters of valve charts.
- G. At conclusion of contract work, provide the Owner's Representative with a complete set of reproducible drawings with all changes clearly marked to reflect as-built conditions. These drawings shall be labeled "As-Built". Updated Coordination drawings can be used as the contract "As-Built" drawings at project completion.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturer's names and model numbers used for materials, processes, or equipment in Division 21, 22, and 23 provide the basis for design and the minimum standards of quality, utility and appearance.

2.2 SUBSTITUTIONS

- A. For substitutions see Division 01.
- B. If not specified in Division 01:
 1. Substitutions only from the list provided.
 2. Contractor is responsible for all alterations required to make substituted product work.

3. Contractor is responsible for all coordination of other trades required by substitution.
4. Contractor is responsible for any engineering and structural or seismic modifications to the equipment supports and structures, etc.

2.3 PIPE, TUBE, AND FITTINGS

- A. Domestic cold water: Hard copper tube, ASTM B 88, Type L water tube, drawn temper. Wrought-copper solder-joint fittings, ASME B16.22, wrought-copper pressure fittings.
- B. Waste and vent: Hubless cast-iron pipe, ASTM A 888 and Husky 2000 series couplings (or approved equal).

2.4 JOINING MATERIALS

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- C. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8 Bag1, silver alloy for refrigerant piping, unless otherwise indicated.

PART 3 - EXECUTION

3.1 DEMOLITION

- A. Comply with the requirements of Division 02.
- B. Remove fixtures and equipment not to remain in service as shown on Drawings or as required. This includes the removal of associated appurtenances and supports.
- C. Patch, cap, or repair existing work affected by this demolition in concealed spaces within six (6) inches of a live main or branch.
- D. Deliver removed materials to be retained by the Owner for storage on-site as directed by the Owner's Representative. Properly dispose of all other removed material off site.
- E. Where hazardous and carcinogenic materials are encountered, stop the work immediately and notify the Owner's Representative.

3.2 PIPING SYSTEMS – COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping 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 tile removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes of direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - 1. New Piping:
 - a. Piping with Fitting or Sleeve protruding from Wall: One-piece, deep pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
 - f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
 - g. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
 - h. Bare piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
- M. Sleeves are not required for core-drilled holes.
- N. Permanent sleeves are not required for holes formed by removable PE sleeves.
- O. Install sleeves for pipes passing through concrete and masonry walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 for materials.

- P. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 for materials.
- Q. Verify final equipment locations for roughing-in.
- R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
- B. Ream ends of pipe and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook", using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook", "Pipe and Tube" chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

3.4 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.5 GROUTING

- A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout. Apply adhesive to existing concrete surfaces to assure bonding.
- C. Place grout, completely filling equipment bases, and surrounding any and all anchors. Avoid air entrainment. Provide a smooth finished surface. Allow grout to cure before placing in service.

3.6 MANUFACTURER'S IDENTIFICATION

- A. Manufacturer's nameplate, name, or trademark shall be permanently affixed to all equipment and materials furnished under this Specification. The nameplates of Subcontractor or Distributor are not acceptable.

3.7 CUTTING AND PATCHING

- A. Comply with requirements of Division 01.
- B. Cut completed Work only where sleeves, openings, chases, and similar items were inadvertently omitted and only with specific permission of the Owner's Representative. In no case shall reinforcing steel be cut without specific written permission of the Owner's Representative.
- C. Provide sleeves, caps, plates, escutcheons, flashing, and similar items required to fill or close the openings.
- D. Provide final grouting, concrete, asphalt, masonry, painting, and other materials as required to complete patch work.
- E. Where cutting occurs on any building fire or smoke compartment separation, repair to maintain the integrity of the separation, including all necessary automatic dampers and UL approved through penetration systems.
- F. Where cutting and patching occurs in streets, sidewalks, alleys, and the like, cooperate fully with the Owner's Representative and municipal or other government bodies to match existing materials.

3.8 OPERATION BY OWNER

- A. The Owner may require operation of parts or all of respective installations prior to final acceptance. Cost of utilities for such operation shall be paid by Owner.

3.9 TEST AND ADJUSTMENTS

- A. Labor, materials, instruments, and power required for testing provided under respective Sections for Work under that Section.
- B. Test shall be performed as specified or as required by regulating authority having jurisdiction. Submit to Owner's Representative certification that tests have been performed in accordance with Contract Documents.

- C. Pressure test piping before connection to equipment. No piping, equipment, or accessories shall be subjected to pressures exceeding their indicated rating.
- D. Repair or replace defective Work and repeat tests until particular systems, and component parts thereof, receive approval of Owner's Representative and regulating authority.
 - 1. Any damages resulting from test shall be repaired and damaged materials replaced at no cost to Owner.
- E. Equipment and systems which normally operate during certain seasons of the year shall be tested during the appropriate season.
 - 1. Perform test on individual equipment, systems, and their controls.
 - 2. Whenever the equipment or system under test is inter-related with, and depends upon the operation of other equipment or systems and their controls for proper operation, functioning, and performance, the latter shall be operated simultaneously with equipment or system being tested.
- F. No piping or ductwork shall be closed up, furred in, or covered before testing. Notify regulating authority and Owner's Representative 3 days before test are to be conducted.
- G. Test all systems as specified under various applicable Sections. Duration of test shall be determined by the authority having jurisdiction and in no case less than the time specified.
- H. Drain water used for testing from the system after test are complete. Repair or replace any damages caused by freezing of water left in system at no expense to the Owner.
- I. Test and balancing of air and hydronic systems specified under other appropriate Sections.

3.10 TERMINATIONS AND CLEANING

- A. The Work includes removing tools, scaffolding, surplus materials, barricades, temporary walks, debris, and rubbish from the Project promptly upon completion of that portion of the Work. Leave the area of operations completely clean and free of these items.
- B. During the course of construction, cap all ducts, pipes, and electrical conduits in approved manner to insure adequate protection against entrance of foreign substances.
- C. Disconnect, clean, and reconnect, whenever necessary, to locate and remove obstructions from any system. Repair or replace any Work damaged in the course of removing said obstructions at no additional cost to the Owner.

3.11 INSTRUCTIONS FOR OWNER'S PERSONNEL

- A. Prior to acceptance of Work and during time designated by the Owner's Representative, provide qualified personnel to operate each system for a period of 48 hours during 2 consecutive work days.
- B. During operating period, fully instruct Owner's personnel in complete operation, adjustment, and maintenance of each system.
- C. See specific sections for additional startup and training procedures.

3.12 PROJECT CLOSEOUT

- A. Special tools or safety equipment: Provide one of each tool or piece of safety equipment required for proper operation and maintenance of equipment installed under this Work.
- B. KEYING: Provide 3 keys for each lock furnished under this Work.

END OF SECTION 220510

SECTION 220529
HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Metal pipe hangers and supports.
 - 2. Fastener systems.

1.3 DEFINITIONS

- A. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers using performance requirements and design criteria by the manufacturer.

1.5 SUBMITTALS

- A. Product Data: For each type as applicable.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
 - 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
 - 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 - 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

2.2 FASTENER SYSTEMS

- A. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated 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.

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. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- C. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- D. 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.
- E. Install lateral bracing with pipe hangers per California Building Code seismic requirements.
- F. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads 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.
- G. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- H. 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.
- I. 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. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.3 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches or less.

3.4 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports and attachments for general service applications.
- F. Isolate hangers from copper piping and tubing with felt lined hangers or 2 layers of 10 mil tape.
- 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 "J" Hangers (MSS type 5) or Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
- J. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- K. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 1. Steel or Malleable Concrete Inserts (MSS Type 18, or Tolco Fig. 109A): 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-joint construction, to attach to top flange of structural shape.

3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

END OF SECTION 22 05 29

**SECTION 22 05 53
PLUMBING IDENTIFICATION**

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Valve identification
 - 2. Piping identification
 - 3. Signage

1.2 REFERENCE STANDARDS

- A. ANSI/ASME A13.1 – Scheme for the Identification of Piping Systems.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: Submit samples of each color, lettering style, and other graphic representation required for each identification material or system.
- C. Schedules:
 - 1. Valve identification chart and schedule, including valve numbering system, valve tag number location, function type, and valve manufacturer's name and model number.
 - 2. Lists of pipe and equipment to be labeled.

1.4 QUALITY ASSURANCE

- A. Coordinate color coding with the University's Representative for preferred color schemes and service abbreviations and valve and equipment numbering schemes prior to submittal review.
- B. Coordinate installation of identifying devices with completion of covering of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices, pipe identification and flow arrows before installing acoustical ceilings and similar concealment.
- E. Coordinate painting schemes of plumbing piping, if required, with University's Representative prior to submittal review.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturer:
 - 1. Brady/Seton
 - 2. Stranco
 - 3. Rowmark
 - 4. Or equal

2.2 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 the Subcontractor or Distributor are not acceptable.

2.3 VALVE IDENTIFICATION

- A. Attached to stem of each control valve and line shutoff valve installed under Division 22, with No. 16 brass chain, color-coded plastic laminate tag. Engrave laminate tags with 1-inch designated numbers in accordance with typed schedule showing valve size, locations, service, similar to the following form:

RW: 3-inches
Shutoff, Toilets
3rd Floor
Column F-8

- 1. Engrave identification tags "normally open" (green) or "normally closed" (red).
 - 2. Do not identify valves where the use is obvious, such as equipment isolation valves.
 - 3. Tag all valves except fixture stops.
 - 4. Label plumbing valves "Plbg" plus valve identification number.
 - 5. Number tags to conform to directory listing number, location, and use.
- B. Access panel markers: Provide manufacturer's standard 1/16 inch thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve. Include 1/8 inch center hole to allow attachment.

2.4 PAINTED IDENTIFICATION MATERIALS

- A. Stencils: Standard fiberboard stencils, prepared for required applications with the letter sizes generally complying with recommendations of ANSI A13.1 for piping and similar applications, but not less than 3/4 inch high letters for access door signs and similar operational instructions.
- B. Stencil Paint: Standard exterior type stenciling enamel; black, except as otherwise indicated; either brushing grade or pressurized spray-can form and grade.
- C. Identification Paint: Standard identification enamel of colors indicated or, if not otherwise indicated for piping systems, comply with ANSI A13.1 for colors.

2.5 PIPE IDENTIFICATION

- A. General requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- C. Small pipes: For external diameters less than 6 inches (including isolation if any), provide full-band pipe markers, extending 360 degrees around pipe at each location, fastened by one of the following methods:
 - 1. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
 - 2. Adhesive lap joint in pipe marker overlap.
 - 3. Laminated or bonded application of pipe marker to pipe (or insulation).
 - 4. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 3/4 inch wide; full circle at both ends of pipe marker, tape lapped 1-1/2 inches.
- D. Large pipes: For external diameters of 6 inches and larger (including isolation if any), provide either full-band or strip-type pipe markers, but not narrower than 3 times letter height (and of required length), fastened by one of the following methods:
 - 1. Laminated or bonded application of pipe marker to pipe (or insulation).
 - 2. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 1-1/2 inch wide; full circle at both ends of pipe marker, tape lapped 3 inches.
 - 3. Strapped to pipe application of semi-rigid type, with manufacturer's standard stainless steel bands.
- E. Pipe Label Contents: Include identification of piping service using piping system nomenclature as specified, scheduled or shown, and abbreviate only as necessary for each application. Include 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.
- F. Locate pipe markers as follows:
 - 1. Within one foot of each valve, fitting, thermometer or gauge (except on plumbing fixtures).
 - 2. At each branch or riser take off.
 - 3. At each passage through walls, floors and ceiling construction.
 - 4. At each pipe passage to underground.
 - 5. On all horizontal pipe runs every 20 ft, at least twice in each room and each story traversed by piping system.
 - 6. Identify piping contents, flow direction, supply and return.
 - 7. Where capped piping is provided for future connections, provide legible and durable tags indicating symbol identification.
 - 8. At wall and ceiling access panels.
 - 9. Practicable variations or changes in locations and spacing may be made with specific approval of the University's Representative to meet specific conditions.

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.
- B. Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

3.2 PIPE SYSTEM IDENTIFICATION

- A. General: Provide for all systems unless indicated otherwise.
- B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 2. Near major equipment items and other points of origination and termination.
 - 3. 50 feet intervals.
- C. Types: Install pipe markers of one of the following types on each system, and include arrows to show normal direction of flow:
 - 1. Stenciled markers, including color-coded background band or rectangle, and contrasting lettering of black or white. Extend color band or rectangle 2 inches beyond ends of lettering.
 - 2. Stenciled markers, with lettering color complying with ANSI A13.1.
 - 3. Plastic pipe markers, with application system as indicated under "Materials" in this Section. Install on pipe insulation segment where required for hot non-insulated pipes.
 - 4. Stenciled markers, black or white for best contrast, wherever continuous color-coded painting of piping is provided.
- D. Locate pipe markers and color bands as follows wherever piping is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums) and exterior non-concealed locations.
 - 1. Near each valve and control device. Within one foot of each valve, fitting, thermometer or gauge (except on plumbing fixtures).
 - 2. At each branch or riser take off, excluding short take-offs for fixtures and terminal units; mark each pipe at branch, where there could be question of flow pattern.
 - 3. At each passage through walls, floors and ceiling construction, or enter non-accessible enclosures.
 - 4. At each pipe passage to underground.
 - 5. At access doors, manholes and similar access points which permit view of concealed piping. At wall and ceiling access panels. Practicable variations or changes in locations and spacing may be made with specific approval of the University's Representative to meet specific conditions.
 - 6. Near major equipment items and other points of origination and termination.
 - 7. Spaced intermediately at maximum spacing of 50 feet (15m) along each piping run, except reduce spacing to 25 feet (8 m) in congested areas of piping and equipment.
 - 8. On all horizontal pipe runs every 20 ft, at least twice in each room and each story traversed by piping system.

9. On piping above removable acoustical ceilings, except omit intermediately spaced markers.
10. Where capped piping is provided for future connections, provide legible and durable tags indicating symbol identification.
11. Identify piping contents, flow direction, supply and return.

3.3 VALVE IDENTIFICATION

- A. General: Provide valve tag on every valve cock and control device in each piping system; exclude check valves, and similar rough-in connections of end-use fixtures and units. List each tagged valve in valve schedule for each piping system.
- B. Valves Concealed in Suspended Ceilings: Provide 1/4-inch-high plastic tape marker identifying the valve number on the nearest ceiling grid member.

3.4 ADJUSTING AND CLEANING

- A. Adjusting: Relocate any plumbing identification device which has become visually blocked by Work of this Division or other Divisions.
- B. Cleaning: Clean face of identification devices.

3.5 EXTRA STOCK

- A. Furnish minimum of 5% extra stock of each plumbing identification material required, including additional numbered valve tags (not less than 3) for each piping system, additional piping system identification markers, and additional plastic laminate engraving blanks of assorted sizes.
 1. Where stenciled markers are provided, clean and retain stencils after completion of stenciling and include used stencils in extra stock, along with required stock of stenciling paints and applicators.

END OF SECTION 22 05 53

**SECTION 220719
PLUMBING PIPING INSULATION**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes insulating the following plumbing piping services:
 - 1. Domestic hot-water piping.

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. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

1.5 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency. Insulation Installed Indoors to have a Flame-spread index of 25 or less, and smoke-developed index of 50 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.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- B. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

- D. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Preformed Pipe Insulation with Factory-Applied ASJ-SSL: Comply with ASTM C 552, Type II, Class 2. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. 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.

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: ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

2.5 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136. Width: 3 inches. Thickness: 11.5 mils. Adhesion: 90 ounces force/inch in width. Elongation: 2 percent. Tensile Strength: 40 lbf/inch in width. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

2.6 SECUREMENTS

- A. Bands:
 - 1. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal or closed seal.

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. Verify that systems to be insulated have been tested and are free of defects. Verify that surfaces to be insulated are clean and dry. 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 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. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets per manufacturer's instructions.
- 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.
- O. For above-ambient services, do not install insulation to the following: Vibration-control devices, Testing agency labels and stamps, Nameplates and data plates, & Cleanouts.

3.4 PENETRATIONS

- A. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
- B. Insulation Installation at Floor Penetrations: Install insulation continuously through floor penetrations.

3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

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 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.

3.7 PIPING INSULATION SCHEDULE, GENERAL

- A. 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. Domestic Hot and Recirculated Hot Water:

1. NPS 1-1/4 and Smaller: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: Thickness per current California Energy Codes.

END OF SECTION 22 07 19

SECTION 22 13 16
SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Pipe, tube, and fittings.
 - 2. Special pipe fittings.

1.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.4 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Manufacturers: "Charlotte Pipe and Foundry Company.", "Dallas Specialty & Mfg. Co.", "NewAge Casting." Or Equal.
- B. Hubless Cast Iron pipe and fittings shall be manufactured from gray cast iron and shall conform to ASTM A 888 and CISPI Standard 301. All pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute and listed by NSF International. Couplings shall comply with Standards ASTM C 1277 and CISPI 310. Stainless-steel corrugated shield with stainless-steel bands and tightening devices. ASTM C 564, rubber sleeve with integral, center pipe stop. As per University design requirements - above or underground no hub waste piping shall use 4-band couplings and no hub sanitary vent piping shall use 2-band couplings.

2.2 CLEANOUTS

- A. Cast-Iron Wall Cleanouts comply with Standard ASME A112.36.2M. Include wall access. Size Same as connected drainage piping. Hubless, cast-iron soil pipe test tee as required to match connected piping.

PART 3 - EXECUTION

3.1 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 at indicated slopes free of sags and bends. Install soil and waste drainage at 2 percent downward in direction of flow. Slope Vent Piping at 1 percent down toward vertical fixture vent or toward vent stack.
- C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. 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.
- G. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- H. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction. Connect drainage piping in sizes indicated, but not smaller than required by plumbing code. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- I. Install sleeve seals for piping penetrations of concrete walls and slabs.
- J. Install escutcheons for piping penetrations of walls, ceilings, and floors.
- K. 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.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments and Install stainless-steel pipe hangers for horizontal piping in corrosive environments. Use MSS Type 1, adjustable, steel clevis hangers. Support horizontal piping and tubing within 12 inches of each fitting and coupling. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.
- B. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters: NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod. NPS 3: 60 inches with 1/2-inch rod. NPS 4 and NPS 5: 60 inches with 5/8-inch rod. NPS 6 and NPS 8: 60 inches

with 3/4-inch rod. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

3.3 IDENTIFICATION

- A. Provide Printed plastic with contact-type, permanent-adhesive backing label. Yellow background with Black lettering at least one inch high. Include flow direction arrow.

3.4 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures. Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements. If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection. Contractor is to prepare inspection reports and have them signed by authorities having jurisdiction.
- B. Clean interior of piping by removing dirt and debris from interior of piping as work progresses. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work. Place plugs in ends of uncompleted piping at end of day and when work stops.
- C. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction. 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.

END OF SECTION 22 13 16

SECTION 22 43 00
HEALTHCARE PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes the following healthcare fixtures and specialties:

1. Water closets
2. Flushometer valves
3. Toilet seats
4. Scrub sinks
5. Handwash sinks
6. Sink faucets
7. Supports and fittings

1.2 SUBMITTALS

- A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, colors, and finishes for fixtures.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For plumbing fixtures and faucets to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All plumbing fixtures, accessories and methods are to be compliant with California AB 1953 Low Lead requirements, and the Safe Drinking Water Act.
- B. Acceptable Manufacturers:
1. American Standard
 2. Kohler
 3. Just Mfg.
 4. Zurn
 5. Or Equal
- C. Coordination: Ensure compatibility between fixture, faucet, waste, and all other appurtenances associated with a plumbing fixture installation.
1. Coordinate sink hole quantity and placement to match faucet
 2. Coordinate water closet spud size with flushometer valve.

2.2 WATER CLOSETS

- A. Water Closets: Wall mounted, top spud, accessible. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5. Material: Vitreous china. Type: Siphon jet. Style: Flushometer valve. Automatic valve with lever handle, or as listed on drawings. Height: Handicapped/elderly.
 - a. Water Consumption: 1.28 gal. per flush, or as listed on drawings
 - b. Spud Size: NPS 1-1/2.
- B. Water Closets: Floor mounted, floor outlet, top spud, accessible. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5. Material: Vitreous china. Type: Siphon jet. Style: Flushometer valve. Automatic valve with lever handle, or as listed on drawings. Height: Handicapped/elderly.
 - a. Water Consumption: 1.28 gal. per flush.
 - b. Spud Size: NPS 1-1/2.

2.3 FLUSHOMETER VALVES

- A. General: ASSE 1037. Minimum Pressure Rating: 125 psig. Integral check stop, backflow-prevention device, and outlet-tube-mounted bedpan washer. Automatic with lever handle, hard-wired. Material: Brass body with corrosion-resistant components. Finish: Chrome plated.
 - 1. Consumption: 1.28 gal. per flush, or as compatible with water closet.
 - 2. Minimum Inlet: NPS 1.
 - 3. Outlet: NPS 1-1/4, extended length.
 - 4. Option: Outlet-tube-mounted bedpan washer.

2.4 TOILET SEATS

- A. Toilet Seats: Standard: IAPMO Z124.5. Material: Plastic with antimicrobial agent. Type: Commercial (heavy duty). Shape: Elongated rim, open front. Hinge: Check. Hinge Material: Noncorroding metal.

2.5 SCRUB SINKS

- A. Scrub Sinks: Stainless steel or vitreous china, wall mounted. Standard: ASME A112.19.3/CSA B45.4. Support: Type II sink carrier. Sink Mounting Height: Handicapped/elderly according to ICC A117.1.

2.6 HANDWASH SINKS

- A. General: Wall or counter mounted stainless steel or vitreous china general purpose sink. Standard: ASME A112.18.1, ASME A112.19.3/CSA B125.1, SCA B45.4. As shown on drawings.
 - 1. Vitreous china counter mount: Waste overflow. Self rimming design. Installation: ADA compliant, unless otherwise specified.
 - 2. Stainless steel counter mount: Type 304 stainless steel, 18 ga minimum. Fully coated underside. Self rimming top. Non-porous brushed finish.
 - 3. Vitreous china wall hung: Waste overflow. Mount using concealed arm carrier system.

2.7 SINK FAUCETS

- A. Sink Faucets: Automatic, hard-wired, electronic-sensor-operated mixing valve. Standards: ASME A112.18.1/CSA B125.1 and UL 1951. Configuration: Hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor. Body Type: Single hole or as listed on drawings. Body Material: Solid brass. Finish: Polished chrome plate.
 - 1. Spout Type: Rigid, gooseneck.

2. Spout Outlet: Laminar flow.

2.8 LAMINAR-FLOW, FAUCET-SPOUT OUTLETS

- A. Description: Chrome-plated brass, faucet-spout outlet that produces non-aerating, laminar stream. Include external or internal thread that mates with faucet outlet for attachment to faucets where indicated and flow-rate range that includes faucet flow.

2.9 SUPPORTS

- A. Description: Waste-fitting assembly as required to match drainage piping material and arrangement with faceplates, couplings gaskets, and feet; bolts and hardware matching fixture.

1. Water Closet Carrier: ASME A112.6.1M.
2. Type I Sink Carrier: ASME A112.6.1M.
3. Type II Sink Carrier: ASME A112.6.1M.
4. Type III Sink Carrier: ASME A112.6.1M.
5. Type IV Sink Carrier: ASME A112.6.1M.

2.10 SUPPLY FITTINGS

- A. Standard: ASME A112.18.1/CSA B125.1.
- B. 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.
- C. Supply Stops: Chrome-plated brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
- D. Operation: Loose key.
- E. Risers: NPS 1/2 chrome-plated, rigid-copper pipe and brass straight or offset tailpieces, or chrome-plated, soft-copper flexible tube.

2.11 WASTE FITTINGS

- A. Standard: ASME A112.18.2/CSA B125.2.
- B. Drain: Grid with NPS 1-1/2 DN 40 tailpiece.
- C. Trap:
1. Size: NPS 1-1/2.
 2. Material: Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch-thick brass tube to wall; and chrome-plated brass or steel wall flange.

2.12 GROUT

- A. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout. Non-shrink; for interior and exterior applications. Design Mix: 5000-psi, 28-day compressive strength.

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 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 floor-mounted healthcare water closets on bowl-to-drain, connecting fitting attachments to piping or building substrate.
- D. Install counter-mounted fixtures in and attached to casework.
- E. 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.
- F. Install laminar-flow, faucet-spout fittings in faucet spouts unless otherwise specified.
- G. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks.
- H. 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.
- I. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings.

3.3 ADJUSTING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Adjust water pressure at faucets and flushometer valves to produce proper flow.
- C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

3.4 CLEANING AND PROTECTION

- A. After installing fixtures, inspect and repair damaged finishes.

- B. Clean 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 23 05 00

BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. The intent of Division 21, 22, and 23 Specifications and Drawings is to provide complete and workable mechanical systems as shown, specified and required by applicable codes. Include all work specified in Division 21, 22 and 23 and shown on the Drawings, including appurtenances, connections, demolition, appliances, and incidental accessories to make work complete and ready for operation.
- B. The Drawings that accompany the Division 21, 22, and 23 Specifications are diagrammatic. They do not show every offset, pipe/duct fitting, or elbow that may be required to install work in the space provided and avoid conflicts. Locations of all items not definitely fixed by dimensions are approximate only. Coordinate Division 21, 22, and 23 work as required by Division 01.
- C. Include minor details not usually shown or specified, but necessary for proper installation and operation of a system or piece of equipment in work and in bid price, the same as if specified or shown.

1.3 ENFORCEABLE CODES

- A. The code publications listed below form a part of this specification. This list is not exclusive, local and other codes may also apply:
 - 1. 2013 California Administrative Code (CAC), Part 1, Title 24, California Code of Regulations (CCR).
 - 2. 2013 California Building Code (CBC), Part 2, Title 24, CCR, (Based on the 2012 International Building Code).
 - 3. 2013 California Electrical Code (CEC), Part 3, Title 23, CCR, (Based on the 2011 National Electrical Code).
 - 4. 2013 California Mechanical Code (CMC), Part 4, Title 24, CCR, (Based on the 2012 Uniform Mechanical Code).
 - 5. 2013 California Plumbing Code (CPC), Part 5, Title 24, CCR, (Based on the 2012 Uniform Plumbing Code).
 - 6. 2013 California Fire Code (CFC), Part 9, Title 24, CCR, (Based on the 2012 International Fire Code).

1.4 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subjected to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
 - 1. CPVC: Chlorinated polyvinyl chloride plastic.
 - 2. PE: Polyethylene plastic.
 - 3. PVC: Polyvinyl chloride plastic
- G. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber
 - 2. NBR: Acrylonitrile-butadiene rubber.

1.5 REFERENCES

- A. Publications and Standards listed below form a part of this specification to the extent referenced. The Publications and Standards are referenced 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.
 - 4. National Electrical Safety Code.
 - 5. National Electrical Testing Association.
 - 6. Underwriter's Laboratories, Inc. Standards.
 - 7. American National Standards Institute.

8. American Society for Testing Materials Standards.
9. National Fire Protection Association Standards.
10. American Society of Mechanical Engineers Boiler and Pressure Vessel Codes.
11. American Water Works Association.
12. Occupational Safety and Health Act.
13. Uniform Mechanical and Plumbing Codes with applicable State of California amendments.
14. Commercial and Industrial Insulation Standards.
15. American Gas Association.
16. American Society of Heating, Refrigerating and Air-Conditioning Engineers.
17. Sheet Metal and Air conditioning Contractor's National Association Standards.
18. Air-Conditioning and Refrigeration Institute Standards.
19. American Welding Society.

1.6 SUBMITTALS

- A. Comply with requirements of Division 01.
- B. Coordination Drawings: Each trade shall be responsible for their own respective coordination drawing effort with the HVAC contractor being the coordination effort team leader. Drawings shall be electronic (AutoCAD) and each trade shall have the ability to coordinate electronically (xref) into each other's drawings for collision checking and spatial conditions. When coordination effort is completed contractors shall sign drawings demonstrating that they are buildable shop drawings. Coordination drawings can also be used as the contract "as-builts" at project completion.
- C. Submit required copies of shop drawings, product data, samples, schedules and reports as required by individual Division 21, 22, and 23 Sections.

1.7 QUALITY ASSURANCE

- A. Provide Work and materials in accordance with the latest rules and regulations of the California State Fire Marshal and the California State Department of Public Health, Titles 17 and 24; the California Plumbing Code and California Mechanical Code, IAPMO; the NFPA Pamphlet 13, 14, 24, 291; and other applicable laws or regulations.
- B. Where the standards of the drawing and specifications for materials and/or workmanship are higher than the requirements of the regulations cited above, the drawings and specifications shall take precedence; otherwise the regulations shall govern.
- C. Provide materials and apparatus that bear the UL label where such label is applicable.

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- D. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code – Steel".
- E. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Protect materials from corrosion and breakage. Store materials above grade. Provide appropriate covering.
- B. Replace any materials which are damaged or degraded by improper storage with new.

1.9 SITE VISITATION

- A. Visit the site prior to bidding and become familiar with existing conditions and other factors which may affect the execution of the work. Include all related cost in the initial bid proposal.

1.10 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08.
- D. Coordinate all equipment, ductwork, and piping layout with other trades.

1.11 WARRANTY

- A. Comply with the requirements of Division 01.
- B. Provide manufacturer's written warranties covering defects in materials and workmanship of products and equipment utilized for this project.
- C. Each complete system shall be warranted for a period of one year from the date of Substantial Completion.
- D. Each system shall be free of defects in materials and workmanship, and shall perform satisfactorily under all conditions of load or service.
- E. The warranties shall provide that all additional controls, protective devices, or equipment be provided as necessary for operation of the system or equipment.
- F. Replace or repair faulty materials or workmanship at no additional cost to the Owner.
- G. See specific sections for additional equipment warranty items.

1.12 OPERATING INSTRUCTIONS MANUALS

- A. Provide 2 copies of complete Manual, bound in booklet form, plus an electronic copy on permanent storage media. Each manual shall contain the following information:
 - 1. List of all equipment with manufacturer's name, model number, and local representative, service facilities, and the normal channel of supply for each item.
 - 2. Manufacturer's literature describing each item of equipment with detailed parts list.
 - 3. Equipment service schedules and IOMs.
 - 4. Equipment warranties.
 - 5. Certificates of Inspection.
 - 6. Record Blueprints and related Shop Drawings.
 - 7. Air and Water Systems Balance Reports.

1.13 RECORD DRAWINGS

- A. Maintain at the site an up to date set of prints of Engineering Drawings which clearly indicate (by shading, coloring or some other acceptable method) the daily extent of Work installed.
- B. Indicate on Drawings changes in elevation, location, or size of material deviating from original design.
- C. Clearly indicate any dimension changes in elevation, location, size or material, and offsets for valves.
- D. Locate all underground, concealed or buried piping by two or more dimensions per turn of pipe between each direction change.
- E. Show all elevations (invert or centerline) with the point of elevation change clearly located.
- F. Number and letter valves to correspond with numbers and letters of valve charts.
- G. At conclusion of contract work, provide the Owner's Representative with a complete set of reproducible drawings with all changes clearly marked to reflect as-built conditions. These drawings shall be labeled "As-Built". Updated Coordination drawings can be used as the contract "As-Built" drawings at project completion.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturer's names and model numbers used for materials, processes, or equipment in Division 21, 22, and 23 provide the basis for design and the minimum standards of quality, utility and appearance.

2.2 SUBSTITUTIONS

- A. For substitutions see Division 01.
- B. If not specified in Division 01:
 - 1. Substitutions only from list provided.
 - 2. Contractor is responsible for all alterations required to make substituted product work.
 - 3. Contractor is responsible for all coordination of other trades required by substitution.
 - 4. Contractor is responsible for any engineering and structural or seismic modifications to the equipment supports and structure, etc.

PART 3 - EXECUTION

3.1 DEMOLITION

- A. Comply with the requirements of Division 02.
- B. Remove fixtures and equipment not to remain in service as shown on Drawings or as required. This includes the removal of associated appurtenances and supports.
- C. Patch, cap, or repair existing work affected by this demolition in concealed spaces within six (6) inches of a live main or branch.
- D. Deliver removed materials to be retained by the Owner for storage on-site as directed by the Owner's Representative. Properly dispose of all other removed material off site.
- E. Where hazardous and carcinogenic materials are encountered, stop the work immediately and notify the Owner's Representative.

3.2 INSTALLATION

- A. General Installation Method:
 - 1. Examine site related work and surfaces before starting work of any Section:
 - a. Report to Owner's Representative, in writing, conditions which will prevent proper execution of this work.
 - b. Beginning work of any Section without reporting unsuitable conditions to Owner's Representative constitutes acceptance of conditions by Contractor.
 - c. Perform any required removal, repair, or replacement of any unacceptable work caused by unsuitable conditions at no additional cost to Owner.
- B. Provide a complete and properly operating system for each item of equipment called for under this work. Install in accordance with equipment manufacturer's written instructions, published standards, the best industry practices, and the Contract Documents.

- C. Make installations in a neat, finished, and safe and professional manner. Install all materials and equipment in accordance with manufacturer's required or recommended procedures.
- D. Coordinate with shop drawings for work done by other trades.
- E. Verify all dimensions by field measurements.
- F. Arrange for chases, sleeves, and openings in other building components during progress of construction, to allow for installation of ductwork and piping.
- G. Coordinate the installation of required supporting devices and sleeves.
- H. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations. Maintain all manufacturer required service clearances.
- I. Install HVAC equipment to allow right of way for piping installed at required slope.
- J. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
- K. Install systems, materials, and equipment to comply with approved submittal data. Comply with arrangements indicated by the Drawings, recognizing that portions of the work are shown only in diagrammatic form.
- L. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, unless otherwise indicated.

3.3 CUTTING AND PATCHING

- A. Comply with requirements of Division 01.
- B. Cut completed Work only where sleeves, openings, chases, and similar items were inadvertently omitted and only with specific permission of the Owner's Representative. In no case shall reinforcing steel be cut without specific written permission of the Owner's Representative.
- C. Provide sleeves, caps, plates, escutcheons, flashing, and similar items required to fill or close the openings.
- D. Provide final grouting, concrete, asphalt, masonry, painting, and other materials as required to complete patch work.
- E. Where cutting occurs on any building fire or smoke compartment separation, repair to maintain the integrity of the separation, including all necessary automatic dampers and UL approved through penetration systems.
- F. Where cutting and patching occurs in streets, sidewalks, alleys, and the like, cooperate fully with the Owner's Representative and municipal or other government bodies to match existing materials.

3.4 OPERATION BY OWNER

- A. The Owner may require operation of parts or all of respective installations prior to final acceptance. Cost of utilities for such operation shall be paid by Owner.

3.5 TEST AND ADJUSTMENTS

- A. Labor, materials, instruments, and power required for testing provided under respective Sections for Work under that Section.
- B. Test shall be performed as specified or as required by regulating authority having jurisdiction. Submit to Owner's Representative certification that tests have been performed in accordance with Contract Documents.
- C. Pressure test piping before connection to equipment. No piping, equipment, or accessories shall be subjected to pressures exceeding their indicated rating.
- D. Repair or replace defective Work and repeat tests until particular systems, and component parts thereof, receive approval of Owner's Representative and regulating authority.
 - 1. Any damages resulting from test shall be repaired and damaged materials replaced at no cost to Owner.
- E. Equipment and systems which normally operate during certain seasons of the year shall be tested during the appropriate season.
 - 1. Perform test on individual equipment, systems, and their controls.
 - 2. Whenever the equipment or system under test is inter-related with, and depends upon the operation of other equipment or systems and their controls for proper operation, functioning, and performance, the latter shall be operated simultaneously with equipment or system being tested.
- F. No piping or ductwork shall be closed up, furred in, or covered before testing. Notify regulating authority and Owner's Representative 3 days before test are to be conducted.
- G. Test all systems as specified under various applicable Sections. Duration of test shall be determined by the authority having jurisdiction and in no case less than the time specified.
- H. Drain water used for testing from the system after test are complete. Repair or replace any damages caused by freezing of water left in system at no expense to the Owner.
- I. Test and balancing of air and hydronic systems specified under other appropriate Sections.

3.6 TERMINATIONS AND CLEANING

- A. The Work includes removing tools, scaffolding, surplus materials, barricades, temporary walks, debris, and rubbish from the Project promptly upon completion of that portion of the Work. Leave the area of operations completely clean and free of these items.
- B. During the course of construction, cap all ducts, pipes, and electrical conduits in approved manner to insure adequate protection against entrance of foreign substances.

- C. Disconnect, clean, and reconnect, whenever necessary, to locate and remove obstructions from any system. Repair or replace any Work damaged in the course of removing said obstructions at no additional cost to the Owner.

3.7 INSTRUCTIONS FOR OWNER'S PERSONNEL

- A. Prior to acceptance of Work and during time designated by the Owner's Representative, provide qualified personnel to operate each system for a period of 48 hours during 2 consecutive work days.
- B. During operating period, fully instruct Owner's personnel in complete operation, adjustment, and maintenance of each system.
- C. See specific sections for additional startup and training procedures.

3.8 PROJECT CLOSEOUT

- A. Special tools or safety equipment: Provide one of each tool or piece of safety equipment required for proper operation and maintenance of equipment installed under this Work.
- B. KEYING: Provide 3 keys for each lock furnished under this Work.

END OF SECTION 23 05 00

SECTION 23 05 23
GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Bronze ball valves.
- B. Related Sections:
 - 1. Division 23 HVAC piping Sections for specialty valves applicable to those Sections only.
 - 2. Division 23 Section "Identification for HVAC Piping and Equipment" for valve tags and schedules.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- 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 applicable to project.

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.

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 HVAC valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:

1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
2. Handwheel: For valves other than quarter-turn types.
3. Handlever: For quarter-turn valves NPS 6 and smaller except plug valves.
4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 5 plug valves, for each size square plug-valve head.
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.
3. Butterfly Valves: With extended neck.

F. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.

2. Grooved: With grooves according to AWWA C606.
3. Solder Joint: With sockets according to ASME B16.18.
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. Two-Piece, Regular-Port, Bronze Ball Valves with Stainless-Steel Trim:

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. Conbraco Industries, Inc.; Apollo Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Hammond Valve.
 - d. Milwaukee Valve Company.
2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Stainless steel.
 - i. Ball: Stainless steel, vented.
 - j. Port: Regular.

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. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Locate valves for easy access and provide separate support where necessary.
- B. Install valves in position to allow full stem movement.

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 valve.

3.5 CHILLED-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:

- 1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
- 2. Ball Valves: Three-piece, regular port.

3.6 HEATING-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:

- 1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
- 2. Ball Valves: Three-piece, regular port.

END OF SECTION 23 05 23

SECTION 23 05 53
HVAC PIPING AND EQUIPMENT IDENTIFICATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Equipment identification
2. Valve, automatic control valves, dampers (including smoke and combination fire/smoke dampers) and automatic control dampers identification
3. Piping and ductwork identification
4. Signage

REFERENCE STANDARDS

- B. ANSI/ASME A13.1 – Scheme for the Identification of Piping Systems.**

1.2 SUBMITTALS

- A. Product Data:** For each type of product indicated.

- B. Samples:** Submit samples of each color, lettering style, and other graphic representation required for each identification material or system.

C. Schedules:

1. Valve identification chart: Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any). Mark valves which are intended for emergency shut-off and similar special uses, by special "flags", in margin of schedule. In addition to mounted copies, furnish extra copies for Maintenance Manuals as specified in Division 1.
2. Automatic control valve identification chart (obtain from the Building Management System contractor for inclusion with this submittal).
3. Damper identification chart (including smoke and combination fire/smoke dampers).
4. Automatic control damper identification chart (obtain from the Building Management System contractor for inclusion with this submittal).
5. Lists of pipe and equipment to be labeled.
6. Include list of wording, symbols, letter size, letter style, and color coding for each system.

1.3 QUALITY ASSURANCE

- A. Coordinate color coding with the University's Representative for preferred color schemes and service abbreviations and valve and equipment numbering schemes prior to submittal review.**
- B. Coordinate installation of identifying devices with completion of covering of surfaces where devices are to be applied.**
- C. Coordinate installation of identifying devices with location of access panels and doors.**
- D. Install identifying devices, pipe identification and flow arrows before installing acoustical ceilings and similar concealment.**

- E. Coordinate painting schemes of piping, if required, with University's Representative prior to submittal review.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer:

1. Brady/Seton
2. Stranco
3. Rowmark
4. Or equal

2.2 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 the Subcontractor or Distributor are not acceptable.

2.3 EQUIPMENT IDENTIFICATION

- A. Properly identify each piece of equipment with nameplates mounted on or near each operations device, including:
 1. Main control and operating valves, safety devices, and hazardous units
 2. Pumps, compressors, and similar motor-driven units
 3. Air handling equipment, fans, coils, fancoil units, unit heaters, filters, sound attenuators, and VAV terminal units
- B. Identify control panels and major control components outside panels with nameplates.
- C. Identify equipment that is out of view behind access doors in unfinished rooms on face of the access door.
- D. Label content:
 1. Include equipment's Drawing designation or unique equipment number. Use same address nomenclature established in the energy management system.
 2. Area served
 3. Year installed
 4. Make and model
 5. Equipment size (in CFM, HP, RPM, etc.)
 6. If on emergency power, indicate source of power

2.4 NAMEPLATES

- A. Provide plastic labels for mechanical engraving with predrilled holes for attachment hardware.
 1. Material: rigid plastic laminated impact acrylic, 2 layer, exterior grade, UV stable
 2. Thickness: 3/16 inch minimum
 3. Maximum label size: Length and width vary for required label content, but no less than 2 inches wide by 1 inch high.
 4. Background color:
 - a. Normal power: Black, matte finish
 - b. Emergency power: Red, matte finish

5. Lettering: White, machine engraved, Futura font, 3/8 inch high, all caps
6. Maximum temperature: Able to withstand up to 160 deg. F.
7. Fasteners: Self-tapping stainless steel screws, except contact type permanent adhesive where screws cannot or should not penetrate substrate.
 - a. Mounting screw type to be #8- 18 x 1 /2 drilling or tapping style, 1/4 inch hex washer head, stainless steel, or similar, appropriate for material in which sign is affixed to. A bead of silicone sealer shall be applied on back of sign and at screw locations prior to affixing sign to equipment.
 - b. For signs larger than 3 inches by 3 inches, use a minimum of 4 mounting screws.

2.5 VALVE TAGS

- A. Attached to stem of each control valve and line shutoff valve installed under Division 22, with No. 16 brass chain, color-coded plastic laminate tag. Engrave laminate tags with 1-inch designated numbers in accordance with typed schedule showing valve size, locations, service, similar to the following form:

RW: 3-inches
Shutoff, Toilets
3rd Floor
Column F-8

1. Engrave identification tags "normally open" (green) or "normally closed" (red).
 2. Do not identify valves where the use is obvious, such as equipment isolation valves.
 3. Tag all valves except fixture stops.
 4. Label HVAC valves "HVAC" plus valve identification number.
 5. Number tags to conform to directory listing number, location, and use.
- B. Access panel markers: Provide manufacturer's standard 1/16 inch thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve. Include 1/8 inch center hole to allow attachment.

2.6 PIPE IDENTIFICATION

- A. General requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- C. Small pipes: For external diameters less than 6 inches (including isolation if any), provide full-band pipe markers, extending 360 degrees around pipe at each location, fastened by one of the following methods:
 1. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
 2. Adhesive lap joint in pipe marker overlap.
 3. Laminated or bonded application of pipe marker to pipe (or insulation).
 4. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 3/4 inch wide; full circle at both ends of pipe marker, tape lapped 1-1/2 inches.
- D. Large pipes: For external diameters of 6 inches and larger (including isolation if any), provide either full-band or strip-type pipe markers, but not narrower than 3 times letter height (and of required length), fastened by one of the following methods:
 1. Laminated or bonded application of pipe marker to pipe (or insulation).

2. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 1-1/2 inch wide; full circle at both ends of pipe marker, tape lapped 3 inches.
 3. Strapped to pipe application of semi-rigid type, with manufacturer's standard stainless steel bands.
- E. Pipe Label Contents: Include identification of piping service using piping system nomenclature as specified, scheduled or shown, and abbreviate only as necessary for each application. Include 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.
- F. Locate pipe markers as follows:
1. Within one foot of each valve, fitting, thermometer or gauge.
 2. At each branch or riser take off.
 3. At each passage through walls, floors and ceiling construction.
 4. At each pipe passage to underground.
 5. On all horizontal pipe runs every 20 ft, at least twice in each room and each story traversed by piping system.
 6. Identify piping contents, flow direction, supply and return.
 7. Where capped piping is provided for future connections, provide legible and durable tags indicating symbol identification.
 8. At wall and ceiling access panels.
 9. Practicable variations or changes in locations and spacing may be made with specific approval of the University's Representative to meet specific conditions.

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.
- B. Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

3.2 DUCTWORK INSTALLATION

- A. Access doors: Provide duct markers or stenciled signs on each access door in ductwork and housings, indicating purpose of access (to what equipment) and other maintenance and operating instructions, and appropriate safety and procedural information.
- B. Concealed doors: Where access doors are concealed above acoustical ceilings or similar concealment, plasticized tags may be installed for identification in lieu of specified signs.
- C. Access doors for fire/smoke dampers: Permanently identify on the exterior by a label with letters not less than 1/2 inch in height reading "FIRE/SMOKE DAMPER".

3.3 PIPE SYSTEM IDENTIFICATION

- A. General: Provide for all systems unless indicated otherwise.
- B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 2. Near major equipment items and other points of origination and termination.
 - 3. 50 feet intervals.
- C. Types: Install pipe markers of one of the following types on each system, and include arrows to show normal direction of flow:
 - 1. Stenciled markers, including color-coded background band or rectangle, and contrasting lettering of black or white. Extend color band or rectangle 2 inches beyond ends of lettering.
 - 2. Stenciled markers, with lettering color complying with ANSI A13.1.
 - 3. Plastic pipe markers, with application system as indicated under "Materials" in this Section. Install on pipe insulation segment where required for hot non-insulated pipes.
 - 4. Stenciled markers, black or white for best contrast, wherever continuous color-coded painting of piping is provided.
- D. Locate pipe markers and color bands as follows wherever piping is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums) and exterior non-concealed locations.
 - 1. Near each valve and control device. Within one foot of each valve, fitting, thermometer or gauge.
 - 2. At each branch or riser take off, excluding short take-offs for fixtures and terminal units; mark each pipe at branch, where there could be question of flow pattern.
 - 3. At each passage through walls, floors and ceiling construction, or enter non-accessible enclosures.
 - 4. At each pipe passage to underground.
 - 5. At access doors, manholes and similar access points which permit view of concealed piping. At wall and ceiling access panels. Practicable variations or changes in locations and spacing may be made with specific approval of the University's Representative to meet specific conditions.
 - 6. Near major equipment items and other points of origination and termination.
 - 7. Spaced intermediately at maximum spacing of 50 feet (15m) along each piping run, except reduce spacing to 25 feet (8 m) in congested areas of piping and equipment.
 - 8. On all horizontal pipe runs every 20 ft, at least twice in each room and each story traversed by piping system.
 - 9. On piping above removable acoustical ceilings, except omit intermediately spaced markers.
 - 10. Where capped piping is provided for future connections, provide legible and durable tags indicating symbol identification.
 - 11. Identify piping contents, flow direction, supply and return.
- E. During back-filling/top soiling of exterior underground piping systems, install continuous underground-type plastic line marker, locate directly over buried line at 12-inches above pipe. Use metallic lined plastic line markers for non-metallic type piping.

3.4 VALVE IDENTIFICATION

- A. General: Provide valve tag on every valve cock and control device in each piping system; exclude check valves, and similar rough-in connections of end-use fixtures and units. List each tagged valve in valve schedule for each piping system.
- B. Valves Concealed in Suspended Ceilings: Provide 1/4 inch high plastic tape marker identifying the valve number on the nearest ceiling grid member.

3.5 MECHANICAL EQUIPMENT IDENTIFICATION

- A. General: Install engraved plastic laminate sign or plastic equipment marker on or near each major item of mechanical equipment and each operational device, as specified herein if not otherwise specified for each item or device.
 - 1. Signs shall be placed on the equipment in a logical location, easily visible to maintenance personnel, e.g. near control panels, disconnect switches, nameplates, on or near equipment main access doors and panels, etc. Sign and drilling locations shall be approved by the University's Representative.
- B. Optional sign types: Where lettering larger than 1 inch height is needed for proper identification, because of distance from normal location of required identification, stenciled signs may be provided in lieu of engraved plastic, verify with University's Representative.
- C. Lettering size: Minimum 1/4 inch high lettering for name of unit where viewing distances less than 24 inches, 1/2 inch high for distances up to 6 feet, and proportionately larger lettering for greater distances. Provide secondary lettering of 2/3 to 3/4 of size of the principal lettering.
- D. Plasticized tags: Where equipment to be identified is concealed above acoustical ceilings or similar concealment, use plasticized tags installed within concealed space to eliminate text in exposed sign (outside concealment). In rooms other than security area, mechanical rooms, storage, etc. use thumbtacks for exposed signs with color coded for each type of equipment. Verify with University's Representative.

3.6 ADJUSTING AND CLEANING

- A. Adjusting: Relocate any mechanical identification device which has become visually blocked by Work of this Division or other Divisions.
- B. Cleaning: Clean face of identification devices.

3.7 EXTRA STOCK

- A. Furnish minimum of 5% extra stock of each mechanical identification material required, including additional numbered valve tags (not less than 3) for each piping system, additional piping system identification markers, and additional plastic laminate engraving blanks of assorted sizes.
 - 1. Where stenciled markers are provided, clean and retain stencils after completion of stenciling and include used stencils in extra stock, along with required stock of stenciling paints and applicators.

END OF SECTION 23 05 53

SECTION 23 05 93

PLUMBING/HVAC FINAL TESTING, ADJUSTING AND BALANCING

PART I - GENERAL

1.1 WORK INCLUDED

- A. Final test and balance of air distribution systems.
- B. Final test and balance of hydronic distribution systems and associated equipment and apparatus of mechanical work.
- C. Setting and adjusting speed and volume of systems, recording data, conducting tests, preparing and submitting reports, and recommending modifications to work as required by contract documents.
- D. Component types of testing, adjusting, and balancing specified in this section includes the following as applied to mechanical equipment:
 - 1. Fans
 - 2. Air handling units
 - 3. Ductwork systems
 - 4. Coils and heat exchangers
 - 5. Piping systems
 - 6. Terminal units
 - 7. Balance Valves for Plumbing systems

1.2 QUALITY ASSURANCE

- A. University's Representative shall hire independent testing agency services and facilities that specializes in testing, analysis, and balancing of hydronic systems and air distribution for heating-cooling systems. Work shall be done by qualified engineering technicians and trained personnel, using instruments certified accurate to limits used in standard practice for testing and balancing of hydronic and air distribution for heating-cooling systems. Agency shall field test air and hydronic flows in accordance with methods set up by Associated Air Balance Council, National Standard Volume 1, latest edition.
- B. Final testing and balancing of the HVAC systems will be contracted directly by the University. The mechanical contractor, however, will be required to coordinate with the designated test and balance contractor in all respects in a manner exactly as if he were a mechanical subcontractor. With the exception of the actual labor of the test and balance contractor, the mechanical contractor shall consider this specification section to be an inclusive part of his contract documents and shall assume necessary compliance therewith, especially substantial completion. The mechanical contractor shall execute his work in close coordination with the test and balance contractor making every effort to provide

complete test and balance systems, responding expeditiously to correct any deficiencies, inadequacies, imbalances, etc. that may be evidenced by the test to those systems. In that regard, cost and labor for the installation, addition, or removal of any shims, sheaves, or other similar items necessary for incremental adjustment of systems or equipment, in order to comply with the requirements to provide complete and balanced systems demonstrated by test and balance tests, will be considered to be part of the base scope of work of this project.

1. Balancing air quantities of supply and exhaust including existing supply and return fans and all existing zone ducts to achieve those given on drawings. Records shall be kept on all air quantities measured, including tests prior to final balance. On systems with economy cycles, measure and record air quantity of supply and return fans with outside air dampers in minimum and maximum positions. Record variations in fan static and brake horsepower. Adjust to maintain constant building pressure.
2. The use of fire dampers as balancing dampers will not be permitted.
3. Primary air balance shall be achieved using variable fan speed, branch duct dampers, and so forth. The dampers on diffusers and registers may be used only for final balance.
4. Measure and record the ampere reading of each motor input after final adjustments have been made. Record nameplate amperage of motors.
5. Tabulate magnetic starter's size, type and manufacturer with heater strip size, type and rating.

C. Reference Standards:

1. AABC - Associated Air Balance Council - A National Standard Volume 1.
2. ASHRAE - American Society of Heating, Refrigerating, and Air Conditioning Engineers, Inc.
3. NEBB - National Environmental Balance Bureau.

1.3 SUBMITTALS

- A. Provide submittals to indicate the extent of work proposed. Submit certified test reports as hereinafter specified signed by Test and Balance Supervisor who performed test and balance work. Provide all submittals in both hard copy and electronic format. Compile the electronic copies entirely in Adobe 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 CDs).
- B. Include identification and types of instruments used and their most recent calibration date with submission of final test report.
- C. Provide submittal of completed balance report prior to request for final mechanical observation of the project.

1.4 JOB CONDITIONS

D. Balance agency shall perform the following during installation phase of systems:

1. Study design specifications and engineering Drawings and prepare schedule to physically inspect mechanical equipment for hydronic and air distribution systems to be tested and balanced. Contractor shall provide balance agency with one copy of Contract Drawings and specifications, mechanical equipment submittals, and change orders necessary for proper balancing of air distribution systems.
2. Balance agency shall make field inspections prior to closing in portions of systems to be balanced. Agency shall verify to its satisfaction that all work, fittings, dampers, balancing devices, etc. are properly fabricated and installed as shown or specified and that Agency will be able to properly balance system.
3. Prepare final test and balancing schedule, test record forms, and necessary technical information about hydronic and air distribution systems for installed heating-cooling equipment.
4. Recommend adjustments and/or corrections to mechanical equipment and hydronic and air distribution systems that are necessary for proper balancing of systems.

PART II - PRODUCTS

2.1 PATCHING MATERIALS

- A. Except as otherwise indicated, use same products as used by original installer for patching holes in insulation, ductwork and housings which have been cut or drilled for test purposes, including access for test instruments, attaching jigs, and similar purposes.
1. At tester's option, plastic plugs with retainers may be used to patch drilled holes in ductwork and housings.

2.2 TEST INSTRUMENTS

- B. Utilize test instruments and equipment for test and balance work required, of type, precision, and capacity as recommended in the following test and balance standards:
1. Comply with AABC's Manual "AABC National Standards," Volume 1.

PART III - EXECUTION

3.1 BALANCING

- A. Upon completion of hydronic and air handling systems, balance agency shall complete tests, analysis, and balance of hydronic and air handling systems for heating-cooling equipment.
- B. This report shall include as minimum, but not be limited to, following design and actual information:
1. Motors, Pumps, and Fans: Horsepower, brake horsepower, revolutions per

minute, actual amperage, and full-load rated current.

2. Supply, Return, and Exhaust Fans: Cubic feet per minute, static pressure, and outlet velocity.
3. Pumps: Suction and discharge pressure.
4. Coils: Gallons per minute, fluid temperature, and air temperature at outlet and inlet.
5. Terminal Air Distribution Units: Cubic feet per minute and inlet static pressure.
6. Inlets, Outlets, and Main Branch Ducts: Air velocity and cubic feet per minute.
7. All Rooms: Air temperature during test.
8. Other information required to establish completely balanced systems.

3.2 BALANCE REQUIREMENTS

- C. Make allowance for air filter resistance at time of tests. Balance main air supplies at design air quantities and at an air resistance across filter bank midway between design specifications for clean and dirty filters. Balance room air supply and exhaust to within 0 and plus 10% of design air quantities for rooms with an air supply, return, or exhaust under 1000 cfm and to within 0 and plus 5% in room where total is 1000 cfm or more, or in rooms with multiple outlets. In all cases, total air quantities supplied to any floor or major zone will be within 0 and plus 5% of design.
- D. After final air and hydronic balance of systems, make adjustments to obtain uniform temperatures as required by actual occupancy.
- E. Take static pressure readings with inclined manometer. Take air velocity readings with instruments of recent calibration. Take final velocity readings with Alnor Velometer, Anemotherm or Vane Type Anemometer, calibrated prior to test and recalibrated at end of test. Include certified correction curves for each calibration as part of record. Certify instruments accurate to standards currently used in common practice for system balance work. Use test cones for diffusers.
- F. Run tests with supply, return, and exhaust systems operating and doors, windows, etc. closed or under regular traffic. If possible, make final readings with cooling coils under load to ensure that static pressures are at maximum.
- G. Adjust deflection of supply outlets to ensure proper and uniform air distribution throughout area served by such outlets.
- H. Work with temperature Control Subcontractor in adjustment of automatic dampers, valves, thermostats, etc. required to maintain proper temperatures in all portions of building.
- I. Contractor responsible for installing heating, cooling, and ventilating equipment shall make any changes, additions, or modifications to dampers, fan drives and motor sheaves, pump impellers, motors, and other equipment necessary for proper air and hydronic balance.

- J. Balance of systems shall be reviewed by University's Representative and during this review Mechanical Contractor shall furnish men, materials, ladders, etc. to enable University's Representative to take all readings as he may direct. If errors are found, Balancing Agency shall readjust system to satisfaction of University's Representative.
- K. Seal shaft at openings, including openings into duct runs.
- L. Determine measured leakage factor by use of hook gauge with connections across installed orifice plate. Submit leakage factor determined by these tests to Contractor for correction.
- M. Submit test equipment used to University's Representative for review before beginning work.

END OF SECTION 230593

**SECTION 23 07 00
HVAC INSULATION**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

- 1. Insulation Materials:
 - a. Flexible elastomeric.
 - b. Mineral fiber.
- 2. Adhesives.
- 3. Mastics.
- 4. Factory-applied jackets.
- 5. Field-applied jackets.
- 6. Tapes.
- 7. Securements.
- 8. Corner angles.

B. Related Sections:

- 1. Division 21 Section "Fire-Suppression Systems Insulation."
- 2. Division 22 Section "Plumbing Insulation."
- 3. Division 23 Section "Metal Ducts" for duct liners.
- 4. Division 33 Section "Underground Hydronic Energy Distribution" for loose-fill pipe insulation in underground piping outside the building.
- 5. Division 33 Section "Underground Steam and Condensate Distribution Piping" for loose-fill pipe insulation in underground piping outside the building.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.4 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.

1.5 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.6 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Aeroflex USA Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.

- c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.
 - d. Or approved equal.
- 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 FSK jacket or III with factory-applied FSP jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. CertainTeed Corp.; Duct Wrap.
 - b. Johns Manville; Microlite.
 - c. Knauf Insulation; Duct Wrap.
 - d. Manson Insulation Inc.; Alley Wrap.
 - e. Owens Corning; All-Service Duct Wrap.
- G. High-Temperature, Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type V, without factory-applied jacket.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Johns Manville; HTB 23 Spin-Glas.
 - b. Owens Corning; High Temperature Flexible Batt Insulations.
 - c. Or approved equal.
- H. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied ASJ. For equipment applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. CertainTeed Corp.; Commercial Board.
 - b. Fibrex Insulations Inc.; FBX.
 - c. Johns Manville; 800 Series Spin-Glas.
 - d. Knauf Insulation; Insulation Board.
 - e. Manson Insulation Inc.; AK Board.
 - f. Owens Corning; Fiberglas 700 Series.
- I. Mineral-Fiber, Preformed Pipe Insulation:
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Fibrex Insulations Inc.; Coreplus 1200.
 - b. Johns Manville; Micro-Lok.
 - c. Knauf Insulation; 1000 Pipe Insulation.
 - d. Manson Insulation Inc.; Alley-K.
 - e. Owens Corning; Fiberglas Pipe Insulation.

2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
3. Type II, 1200 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type II, Grade A, with factory-applied ASJ-SSL. 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. When used inside the weatherproofing system of the building, use products with VOC limits less than those identified below. Meet more stringent local requirements where they exist.
 1. Contact Adhesives: 80 g/L.
 2. Special Purpose Contact Adhesives: 250 g/L.
 3. General Purpose Mist Spray Adhesive: 65% VOCs by weight.
 4. General Purpose Web Spray Adhesive: 55% VOCs by weight.
 5. Special Purpose Aerosol Adhesive: 70% VOCs by weight.
- C. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
- D. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Aeroflex USA Inc.; Aero seal.
 - b. Armacell LCC; 520 Adhesive.
 - c. Foster Products Corporation, H. B. Fuller Company; 85-75.
 - d. RBX Corporation; Rubatex Contact Adhesive.
- E. PVC Jacket Adhesive: Compatible with PVC jacket.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Chemical Company (The); 739, Dow Silicone.
 - b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. P.I.C. Plastics, Inc.; Welding Adhesive.
 - d. Speedline Corporation; Speedline Vinyl Adhesive.

2.3 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
 1. For indoor applications, use mastics that have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-35.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-90.
 - c. ITW TACC, Division of Illinois Tool Works; CB-50.
 - d. Marathon Industries, Inc.; 590.
 - e. Mon-Eco Industries, Inc.; 55-40.
 - f. Vimasco Corporation; 749.
2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perms at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
5. Color: White.

C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-10.
 - b. Foster Products Corporation, H. B. Fuller Company; 35-00.
 - c. ITW TACC, Division of Illinois Tool Works; CB-05/15.
 - d. Marathon Industries, Inc.; 550.
 - e. Mon-Eco Industries, Inc.; 55-50.
 - f. Vimasco Corporation; WC-1/WC-5.
2. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 200 deg F.
4. Solids Content: 63 percent by volume and 73 percent by weight.
5. Color: White.

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 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in interior field-applied jacket schedules.

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1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Johns Manville; Zeston.
 - b. P.I.C. Plastics, Inc.; FG Series.
 - c. Proto PVC Corporation; LoSmoke.
 - d. Speedline Corporation; SmokeSafe.
2. Adhesive: As recommended by jacket material manufacturer.
3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
4. Factory-fabricated tank heads and tank side panels.

D. Exterior Metal Jacket:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; Metal Jacketing Systems.
 - b. PABCO Metals Corporation; Surefit.
 - c. RPR Products, Inc.; Insul-Mate.
 - d. Or approved equal.
2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.
 - a. Sheet and roll stock ready for shop or field sizing or Factory cut and rolled to size.
 - b. Finish and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barriers for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper, 3-mil- thick, heat-bonded polyethylene and kraft paper, or 2.5-mil-thick Polysurlyn.
 - d. Moisture Barriers for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper or 2.5-mil- thick Polysurlyn.
 - e. Field or Factory Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.
 - 6) Beveled collars.
 - 7) Valve covers.
 - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.6 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, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
 - b. Compac Corp.; 104 and 105.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 2. Width: 3 inches.
 3. Thickness: 11.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - b. Compac Corp.; 110 and 111.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
 - d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
 2. Width: 3 inches.
 3. Thickness: 6.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - b. Compac Corp.; 120.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
 - d. Venture Tape; 3520 CW.
 2. Width: 2 inches.
 3. Thickness: 3.7 mils.
 4. Adhesion: 100 ounces force/inch in width.
 5. Elongation: 5 percent.
 6. Tensile Strength: 34 lbf/inch in width.

2.7 SECUREMENTS

- A. Bands:

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1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products; Bands.
 - b. PABCO Metals Corporation; Bands.
 - c. RPR Products, Inc.; Bands.
2. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing or closed seal.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; CWP-1.
 - 2) GEMCO; CD.
 - 3) Midwest Fasteners, Inc.; CD.
 - 4) Nelson Stud Welding; TPA, TPC, and TPS.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; CWP-1.
 - 2) GEMCO; Cupped Head Weld Pin.
 - 3) Midwest Fasteners, Inc.; Cupped Head.
 - 4) Nelson Stud Welding; CHP.
3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
 - 2) GEMCO; Perforated Base.
 - 3) Midwest Fasteners, Inc.; Spindle.
 - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.

- d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
- 4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) GEMCO; Nylon Hangers.
 - 2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
 - 3) Or approved equal.
 - b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
 - c. Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
- 5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.
 - 2) GEMCO; Press and Peel.
 - 3) Midwest Fasteners, Inc.; Self Stick.
 - b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive-backed base with a peel-off protective cover.
- 6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; RC-150.
 - 2) GEMCO; R-150.
 - 3) Midwest Fasteners, Inc.; WA-150.
 - 4) Nelson Stud Welding; Speed Clips.
 - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

- a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- 1) Midwest Fasteners, Inc.
- 2) Or approved equal.

- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

2.8 CORNER ANGLES

- A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
- B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105 or 5005; Temper H-14.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
1. Verify that systems and equipment to be insulated have been tested and are free of defects.
 2. Verify that surfaces to be insulated are clean and dry.
 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints.
- 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.
- 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 outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above ambient services, do not install insulation to the following:
 - 1. Vibration-control devices.
 - 2. Testing agency labels and stamps.
 - 3. Nameplates and data plates.
 - 4. Manholes.
 - 5. Handholes.

6. Cleanouts.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 1. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 2. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
 1. Comply with requirements in Division 07 Section "Penetration Firestopping" firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
 1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
 2. Pipe: Install insulation continuously through floor penetrations.
 3. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings:

1. Install insulation over fittings, 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.
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.
4. 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.
5. 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.

3.6 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
 2. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
 4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install pre-cut fiberglass inserts, same thickness as adjacent pipe insulation.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
 2. Install insulation to flanges as specified for flange insulation application.
- E. 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 bottoms with dimensions 24 inches and larger, 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 48 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 1 edge and 1 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 2 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.
- F. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 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 bottoms with dimensions 24 inches and larger, 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 48 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 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 2 times the insulation thickness but not less than 3 inches.

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.8 FIELD-APPLIED JACKET INSTALLATION

- A. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- B. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.9 FINISHES

- A. Duct, Equipment, and Pipe Insulation with ASJ-SSL Jacketing.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Do not field paint aluminum jackets.

3.10 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 1. Inspect ductwork as installed.
- D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.11 DUCT INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation:
 1. Indoor, concealed supply and outdoor air.
 2. Indoor, exposed supply and outdoor air.

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. Flexible connectors.
4. Vibration-control devices.
5. Factory-insulated access panels and doors.
6. Indoor, concealed and exposed return air ducts.

3.12 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, supply-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: Minimum R-Value of 4.2.

B. Concealed, outdoor-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: Minimum R-Value of 4.2.

C. Exposed, supply-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: Minimum R-Value of 4.2.

D. Exposed, outdoor-air duct insulation shall be the following:

1. Mineral-Fiber Board: Minimum R-Value of 4.2.

3.13 EQUIPMENT INSULATION SCHEDULE

A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.

B. Insulate indoor and outdoor equipment in paragraphs below that is not factory insulated.

3.14 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.

3.15 INDOOR AND OUTDOOR PIPING INSULATION SCHEDULE

A. Chilled Water:

1. NPS 1-1/4 and Smaller: Insulation shall be one of the following:
 - a. Mineral-Fiber, Preformed Pipe, Type I or Pipe Insulation Wicking System: 0.5 inch thick. Mineral fiber blanket allowed at indoor fittings where conditions prohibit preformed insulation.
2. NPS 1-1/2 to NPS 12: Insulation shall be one of the following:
 - a. Cellular Glass: 1 inches thick.

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- b. Mineral-Fiber, Preformed Pipe, Type I or Pipe Insulation Wicking System: 1 inches thick. Mineral fiber blanket allowed at indoor fittings where conditions prohibit preformed insulation.
- B. Heating-Hot-Water Supply and Return:
 - 1. NPS 1 ½ to NPS 12: Insulation shall be one of the following:
 - a. Mineral-Fiber, Preformed Pipe, Type I: 2 inches thick.
 - 2. NPS 1 ¼ and smaller: Insulation shall be one of the following:
 - a. Mineral-Fiber, Preformed Pipe, Type I: 1-1/2 inches thick.

END OF SECTION 23 07 00

SECTION 230923
BUILDING AUTOMATION CONTROL SYSTEM (BACS)

PART 1 - GENERAL

1.01 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.

1.02 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.
- B. SCADA Operational Protocol: Provide system which complies with applicable sections of the "Cyber Security Procurement Language for Control Systems" as developed and published by the Department of Homeland Security (DHS) – September 2009 (http://ics-cert.us-cert.gov/sites/default/files/FINAL-Procurement_Language_Rev4_100809_0.pdf).

1.03 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 Adobe 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).

1.04 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.

1.05 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.

1.06 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

2.01 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.

2.02 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. 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, Delta-P FDP or HDP series from Flow Control Industries or equal. All control valves shall fail in the last position. Maximum pressure drop at rated flow shall be 5 psig. Maximum pressure drop at rated flow shall be 5 psig.
 - 3. All control valves shall be electronically operated. For valves larger than 8 inch, electro-hydraulic actuators shall be used.
 - 4. Control valves for air handling units, heating hot water, main chilled water, domestic hot water and heat recovery systems shall be Delta P pressure independent modulating type by Flow Control Industries or equal. Maximum pressure drop at rated flow shall be 5 psig.
- C. 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.
- D. 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.

- E. Occupant temporary override switches will not be provided unless otherwise specified.

2.03 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 16 lighting control system tied to Metasys via BACNET. JCI integrator for the addition of new medical gas points to the Nellcor/Puritan Bennett medical gas system. The BACS server shall have the capability to request and successfully process electrical monitoring data on-demand from the GE PMCS host server on a peer-to-peer basis.
- 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.

2.04 FMS ARCHITECTURE

- A. Overall Conceptual Description
 - 1. The FMS shall be designed entirely for use on intranets and internets. All networking technology used at the Tier 1 level shall be off the shelf, industry standard technology fully compatible with other owner provided networks in the facility.
 - 2. All aspects of the user interface, whether to servers or to Tier 1 solid-state devices, shall be via browsers. Any PCs used as operator interface points shall not require the purchase of any special software from the manufacturer in order to provide the complete user interface as described herein.
 - 3. The user interface will be complete as described herein, providing complete tool sets, operational features, multi-panel displays, and other display features. Systems that merely provide HTML based web pages as the operator interface will not be acceptable.

4. The primary components of the system will be the Primary Application Nodes and Servers located at the highest level of the network architecture. Both will use the same user interface and provide the same level of accessibility via the network. The only distinction between the user interface used on servers as compared to Primary Application Nodes will be select menu items used for accessing long term storage features on the servers or on their respective archive devices (CD/RW, etc.)

B. General

1. The FMS shall consist of a number of Nodes and associated equipment connected by 3industry standard network practices. All communication between Nodes shall be by digital means only.
2. The FMS network shall at minimum comprise of the following:
 - a. Operator PCs – fixed or portable.
 - b. Network processing, data storage and communication equipment including file servers.
 - c. Routers, bridges, switches, hubs, modems and like communications equipment.
 - d. Active processing Nodes including field panels.
 - e. Intelligent and addressable elements and end devices.
 - f. Third-party equipment interfaces.
 - g. Other components required for a complete and working FMS.
3. All FMS features shall be accessible via Enterprise Intranet and Internet browser with equivalent FMS access control for user access.
4. The FMS shall support auto-dial/auto-answer communications to allow FMS Nodes to communicate with other remote FMS Nodes via standard telephone lines. Refer to drawings for type of line to be used, DSL or voice grade. Where no preference is indicated, DSL is the preferred grade.
5. The PC Workstations, File servers and principal network equipment shall be standard products of recognized major manufacturers available through normal PC vendor channels. "Clones" are not acceptable.
6. Provide licenses for all software residing in the FMS system and transfer these licenses to the Owner prior to completion.

C. Network

1. The FMS shall incorporate a primary Tier 1 network. At the Contractor's option, the FMS may also incorporate integrated Secondary Tier 2 and tertiary Tier 3 networks.

2. The FMS Network shall utilize an open architecture capable of all of the following:
 - a. Utilizing standard Ethernet communications and operate at a minimum speed of 10/100 Mb/sec
 - b. Connecting via BACnet at the Tier 1 level in accordance with as per ANSI/ASHRAE Standard 135-2001.
 - c. Connecting via the N2 Protocol at the Tier 2 level.
 - d. Connecting via LonMark as per ANSI/EIA 709 (LonWorks) to LonMark FTT-10 transceivers at the Tier 2 level.
 3. The FMS network shall support both copper and optical fiber communication media. Fiber cable, fiber modules or other fiber equipment shall not be provided if copper is selected.
- D. Third-Party Interfaces
1. FMS Contractor shall integrate real-time data from systems supplied by other trades as required.
 2. The FMS system shall include necessary FMS hardware equipment and software to allow data communications between the FMS system and systems supplied by other trades.
 3. The trade contractor supplying other systems will provide their necessary hardware and software and will cooperate fully with the FMS contractor in a timely manner at their cost to ensure complete data integration.
- E. Uninterruptible Power Supply (UPS)
1. Where indicated for supporting operator PCs, servers, and other equipment as indicated, provide a UPS as required.
 2. UPS shall be sized for 50% spare capacity. The UPS shall be complete with batteries, external bypass and line conditioning.
- F. Power Fail / Auto Restart
1. Provide for the automatic orderly and predefined shutdown of parts or all of the FMS following total loss of power to parts or all of the FMS.
 2. Provide for the automatic orderly and predefined startup of parts or all of the FMS following total loss of power to those parts or all of the FMS. Archive and annunciate time and details of restoration.
 3. Provide for the orderly and predefined scheduling of controlled return to normal, automatically time scheduled, operation of controlled equipment as a result of the auto restart processes.

4. Maintain the FMS real-time clock operation during periods of power outage for a minimum of 72 hours.

G. Downloading and Uploading

1. Provide the capability to generate FMS software-based sequences, database items and associated operational definition information and user-required revisions to same at any Operator PC, and the means to download same to the associated Application Node.
2. Application software tool used for the generation of custom logic sequences shall be resident in both the application node and the server(s) where indicated on the drawings.
3. Provide the capability to upload FMS operating software information, database items, sequences and alarms to the designated server(s).
4. The functions of this Part shall be governed by the codes, approvals and regulations applying to each individual FMS application.

2.05 OPERATOR INTERFACE

A. General

1. The FMS Operator Interface shall be user friendly, readily understood and shall make maximum use of colors, graphics, icons, embedded images, animation, text based information and data visualization techniques to enhance and simplify the use and understanding of the FMS by authorized users at the OWS.
2. It shall be possible to designate any PC on the Tier 1 network as an Operator Interface point. No special software will need to be purchased from the FMS manufacturer for any such PC.
3. User access to the FMS shall be protected by a flexible and Owner redefinable software-based password access protection. Password protection shall be multi-level and partitionable to accommodate the varied access requirements of the different user groups. Provide the means to define unique access privileges for each individual authorized user. Also provide the means to establish general password groups to which an individual will then be assigned. Once assigned to the group each individual will assume all the capabilities and restrictions of that group. Provide the means to on-line manage password access control under the control of a Master Password.
4. The user interface shall be able to combine data from any and all of the system components in a single browser window. This shall include historical data stored on a server.
5. The Operator Interface shall incorporate comprehensive support for functions including, but not necessarily limited to, the following:
 - a. User access for selective information retrieval and control command execution

- b. Monitoring and reporting
 - c. Means for the controlled re-programming, re-configuration of FMS operation and for the manipulation of FMS database information in compliance with the prevailing codes, approvals and regulations for individual FMS applications.
- 6. Provide FMS reports and displays making maximized use of simple English language descriptions and readily understood acronyms, abbreviations and the like to assist user understanding and interpretation. All text naming conventions shall be consistent in their use and application throughout the FMS.
- 7. All PC-based configurations shall operate on Microsoft® Windows 10.
- 8. Each fixed and portable PC shall be on-line configurable for specific applications, functions and groups of FMS points.
- B. Navigation Trees
 - 1. The system will have the capability to display multiple navigation trees that will aid the operator in navigating throughout all systems and points connected. At minimum provide a tree that identifies all systems on the networks.
 - 2. Provide the ability for the operator to add custom trees. The operator will be able to define any logical grouping of systems or points and arrange them on the tree in any order. It shall be possible to nest groups within other groups. Provide at minimum 5 levels of nesting.
 - 3. The navigation trees shall be “dockable” to other displays in the user interface such as graphics. This means that the trees will appear as part of the display, but can be detached and then minimized to the Windows task bar or closed altogether. A simple keystroke will reattach the navigation to the primary display of the user interface.
- C. Dividable display panels
 - 1. It shall be possible for the operator to divide the display area within a single browser window into multiple display panels. The content of each display panel can be any of the standard summaries and graphics provided by the system.
 - 2. Provide each display panel with minimize, maximize, and close icons.
- D. Alarms
 - 1. Alarms shall be routed directly from primary application nodes to PCs and servers. It shall be possible for specific alarms from specific points to be routed to specific PCs and servers. The alarm management portion of the OWS software shall, at the minimum, provide the following functions
 - a. Log date and time of alarm occurrence.

- b. Generate a "Pop-Up" window, with audible alarm, informing a user that an alarm has been received.
 - c. Allow a user, with the appropriate security level, to acknowledge, temporarily silence, or discard an alarm.
 - d. Provide an audit trail on hard drive for alarms by recording user acknowledgment, deletion, or disabling of an alarm. The audit trail shall include the name of the user, the alarm, the action taken on the alarm, and a time/date stamp.
 - e. Provide the ability to direct alarms to an e-mail address or alpha-numeric pager. This must be provided in addition to the pop up window described above. Systems which use e-mail and pagers as the exclusive means of annunciating alarms are not acceptable.
 - f. Any attribute of any object in the system may be designated to report an alarm.
- 2. The FMS shall annunciate diagnostic alarms indicating system failures and non-normal operating conditions
 - 3. The FMS shall annunciate application alarms at a minimum.

E. Reports

- 1. Reports shall be generated and directed to one or more of the following: User interface displays, printers, or archive at the user's option. As a minimum, the system shall provide the following reports:
 - a. All points in the FMS.
 - b. All points in each FMS application.
 - c. All points in a specific AN.
 - d. All points in a user-defined group of points.
 - e. All points currently in alarm in an FMS application.
 - f. All points locked out in an FMS application.
 - g. All FMS schedules.
 - h. All user defined and adjustable variables, schedules, interlocks and the like.
 - i. FMS diagnostic and system status reports.
- 2. Provide all applicable standard reports of the FMS manufacturer.
- 3. Provide for the generation by the user of custom reports.

F. Dynamic Color Graphics

1. An unlimited number of graphic displays shall be able to be generated and executed.
2. Graphics shall be based on Scalar Vector Graphic (SVG) technology.
3. Values of real time attributes displayed on the graphics shall be dynamic and updated on the displays.
4. The graphic displays shall be able to display and provide animation based on real-time FMS data that is acquired, derived, or entered.
5. The user shall be able to change values (set points) and states in system controlled equipment directly from the graphic display.
6. Provide a graphic editing tool that allows for the creation and editing of graphic files. It shall be possible to edit the graphics directly while they are on line, or at an off line location for later downloading to the AN.
7. FMS system shall be provided with a complete user expandable symbol library containing all of the basic symbols used to represent components of a typical FMS system. Implementing these symbols in a graphic shall involve dragging and dropping them from the library to the graphic.

G. Schedules

1. The system shall provide multiple schedule input forms for automatic FMS time-of-day scheduling and override scheduling of FMS operations. At a minimum, the following spreadsheet types shall be accommodated:
 - a. Weekly schedules.
 - b. Temporary override schedules.
 - c. Special "Only Active If Today Is A Holiday" schedules.
 - d. Monthly schedules.
2. Schedules shall be provided for each system or sub-system in the FMS. Each schedule shall include all commandable points residing within the system. Each point may have a unique schedule of operation relative to the system use schedule, allowing for sequential starting and control of equipment within the system. Scheduling and rescheduling of points shall be accomplished easily via the system schedule spreadsheets.
3. Monthly calendars for a 12-month period shall be provided that allow for simplified scheduling of holidays and special days in advance. Holidays and special days shall be user-selected with the pointing device or keyboard, and shall automatically reschedule equipment operation as previously defined on the weekly schedules.

H. Historical trending and data collection

1. Trend and store point history data for all FMS points and values as selected by the user.
2. The trend data shall be stored in a manner that allows custom queries and reports using industry-standard software tools.
3. At a minimum, provide the capability to perform statistical functions on the historical database:
 - a. Average.
 - b. Arithmetic mean.
 - c. Maximum/minimum values.
 - d. Range – difference between minimum and maximum values.
 - e. Standard deviation.
 - f. Sum of all values.
 - g. Variance.

I. Paging

1. Provide the means of automatic alphanumeric paging of personnel for user-defined FMS events.
 - a. System shall support both numeric and alpha-numeric pagers, using Alphanumeric, PET, or IXO Protocol at the owner's option.
 - b. Users shall have the ability to modify the phone number or message to be displayed on the pager through the system software.
 - c. System shall utilize pager schedules to send pages to the personnel that are "on-call".
 - d. Contractor shall be responsible for providing a modem for connection to the paging service.

2.06 APPLICATION NODES

A. Primary Application Nodes

1. The primary application node shall perform the function of monitoring all system variables, both from real hardware points, software variables, and controller parameters such as set points.
2. Application nodes shall be entirely solid state devices. No rigid disk drives will be permitted in the equipment rooms.

3. The primary application nodes shall manage and direct all information traffic on the Tier 1 network, between the Tier 1 and Tier2 networks, and to servers.
4. Any node on the Tier 1 network shall be equipped with all software necessary to drive the complete user interface including graphics on a browser connected to the node via the network or directly via a local port on the node.
5. The operating system of the application node shall support multi-user access. At minimum four users shall be able to access the same application node simultaneously.
6. Communication between nodes shall be per-to-peer via 10/100 Ethernet using the BACnet protocol.
7. The AN shall be capable of direct connection to multiple field busses using different protocols simultaneously as indicated below. Should the controller not support multiple field busses, install two primary nodes side by side.
 - a. An RS-485 serial field bus such as MSTP or the manufacturer's proprietary field bus.
 - b. A LON field bus for supervision and control of LON based controllers that conform to the Lon Talk standard.
8. The primary nodes will integrate data from both field busses into a common object structure. Data from both field busses will appear in common displays throughout the user interface in exactly the same format. It shall not be possible to determine which field buss the data originated on without reviewing the system configuration data.
9. AN shall be programmable and governed by the requirements of their applicable codes, approvals and regulations.
10. The AN shall be designed, packaged, installed, programmed and commissioned in consideration of their specific service and prevailing operating conditions. They shall be proven standard product of their original manufacturer and not a custom product for this Project.
11. A failure at an AN shall not cause failures or non-normal operation at any other system AN other than the possible loss of active real-time information from the failed AN.
12. Ancillary AN equipment, including interfaces and power supplies, shall not be operated at more than 80% of their rated service capacity.
13. AN shall comply with FCC Part 15 subpart J class A emission requirements.
14. Each primary node shall be equipped with the necessary un-interruptible power such that it will not cease operation during minor power outages, including those that occur upon transfer to emergency generator or other local power source not provided by the utility.

B. HVAC Node

1. HVAC Node shall provide both standalone and networked direct digital control of HVAC systems.
2. A dedicated HVAC Node shall be configured and provided for each primary HVAC system (air handler, chiller, boiler) and each terminal HVAC system (VAV Box, Unit Heater, Fan Coil Unit, Cabinet Heater, Heat Pump, Fan Powered Box, CV Box).
3. Each HVAC Node shall retain program, control algorithms, and setpoint information in non-volatile memory in the event of a power failure, and shall return to normal operation upon restoration of power.
4. Each HVAC Node shall report its communication status to the FMS. The FMS shall provide a system advisory upon communication failure and restoration.
5. For each primary HVAC system, provide means of indication of system performance and setpoints at, or adjacent to the HVAC Node.
6. For each primary HVAC system, provide a means to adjust setpoints and start/stop equipment at, or adjacent to the HVAC Node.
7. Provide a means to prevent unauthorized personnel from accessing setpoint adjustments and equipment control functions.
8. The HVAC Node shall provide the ability to download and upload configuration data, both locally at the Node and via the FMS communications network.
9. The HVAC Node shall be provided with a permanently-mounted local graphic terminal where required in the sequences of this specification. The local graphic terminal shall provide dynamic graphical representation of the associated system status, with the ability for the operator to enter commands with proper password protection.

2.07 APPLICATION SOFTWARE

A. HVAC Application Software

1. Event Messaging: Provide for the automatic execution of user-defined messages on the occurrence of each predefined FMS real-time event including equipment/point status change, approaching limit or alarm, time of day and the like. Direct messages to any number of operator PCs, e-mail destinations, and pagers.
2. Indoor Air Quality: Provide monitoring of outside air, return air and supply air CO2 concentration, calculate and maintain fresh air requirements. Adjust outdoor air intake to ensure return air CO2 high level limit is not exceeded.
3. Optimum Start/Stop: Provide software to start equipment on a sliding schedule based upon indoor and outdoor conditions, to determine the minimum time of HVAC system operation needed to satisfy the space environmental requirements. The program shall also determine the earliest possible time to stop the mechanical

systems. The optimum start/stop program shall operate in conjunction with, and be coordinated with, the scheduled start/stop and night setback programs.

4. Auto Alarm Lockout: Provide for scheduled and automatic lockout of alarm annunciation from equipment during non-normal operating conditions including shutdown, emergency power operation, fire alarm and the like.
5. Energy monitoring: Provide software to monitor and totalize consumption as measured by pulse meters.
6. Event Initiated Programs and custom logic: Provide software to define custom logic sequences that will reside in the nodes. The definition software will also reside in the node and be accessible via the standard user interface via a browser.
7. System Restart: Upon restoration of the AC power to an HVAC Node, automatically restart all equipment and restore all loads to the state as required by the FMS. Provide appropriate time delays to prevent demand surges or overload trips.
8. Heavy Equipment Delays: The system shall provide protection against excessive demand situations during start-up periods by automatically introducing time delays between successive start commands to heavy electrical loads.

Runtime Totalization: Automatically sample, calculate and store runtime hours for binary input and output points as listed in the point schedule of this specification.

9. Analog/Pulse Totalization: Sample, calculate and store consumption totals on a daily, weekly, or monthly basis for user-selected analog and binary pulse input-type points.

2.08 NETWORKING/COMMUNICATIONS:

- A. The design of the Building Automation Control System shall network operator workstations and Standalone DDC Panels as shown on the attached system configuration drawing. Inherent in the system's design shall be the ability to expand or modify the network(s) either via the local area network, or auto-dial telephone line modem connections, or via a combination of the two networking schemes.

1. Local Area Network

- a. Workstation/DDC Panel Support: Operator workstations and DDC panels shall directly reside on a local area network such that communications may be executed directly between controllers, directly between workstations, and between controllers and workstations on a peer-to-peer basis.
- b. Dynamic Data Access: All operator devices, either network resident or connected via dial-up modems, shall have the ability to access all point status and application report data, or execute control functions for any and all other devices via the local area network. Access to data shall be based upon logical identification of building equipment. Access to system data shall not be restricted by the hardware configuration of the Building Automation Control System. The hardware configuration of the Building

Automation Control System network shall be totally transparent to the user when accessing data or developing control programs.

- c. General Network Design: Network design shall include the following provisions:
- 1) High-speed data transfer rates for alarm reporting, quick report generation from multiple controllers and upload/download efficiency between network devices. The minimum baud rate shall be one (1) Megabaud.
 - 2) Support of any combination of controllers and operator workstations directly connected to the local area network. A minimum of fifty (50) devices shall be supported on a single local area network.
 - 3) Detection and accommodation of single or multiple failures of either workstations, DDC panels or the network media. The network shall include provisions for automatically reconfiguring itself to allow all operational equipment to perform their designated functions as effectively as possible in the event of single or multiple failures.

Message and alarm buffering to prevent information from being lost.

- 4) Error detection, correction, and retransmission to guarantee data integrity.
- 5) Default device definition to prevent loss of alarms or data, and ensure alarms are reported as quickly as possible in the event an operator device does not respond.
- 6) Commonly available, multiple sourced, networking components and protocols shall be used to allow the Building Automation Control System to coexist with other networking applications such as office automation. MAP, ETHERNET, IBM Token Ring and ARCNET are acceptable technologies.
- 7) Use of an industry standard IEEE 802.x protocol. Communications must be of a deterministic nature to assure calculable performance under worst-case network loading.
- 8) Synchronization of the real-time clocks in all DDC panels shall be provided.

2.09 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.

2.10 SYSTEM SOFTWARE FEATURES:

- A. General
 - 1. All necessary software to form a complete operating system as described in this specification shall be provided, including graphical system displays where specified.
 - 2. The software programs specified in this section shall be provided as an integral part of the DDC panel and shall not be dependent upon any higher level computer for execution.
- B. Control Software Description:
 - 1. Pre-Tested Control Algorithms: The DDC panels shall have the ability to perform the following pre-tested control algorithms:

- a. Two Position Control
 - b. Proportional Control
 - c. Proportional plus Integral Control
 - d. Proportional, Integral, plus Derivative Control
 - e. Automatic Control Loop Tuning.
 2. Equipment Cycling Protection: Control software shall include a provision for limiting the number of times each piece of equipment may be cycled within any one-hour period.
 3. Heavy Equipment Delays: The system shall provide protection against excessive demand situations during start-up periods by automatically introducing time delays between successive start commands to heavy electrical loads.
 4. Powerfail Motor Restart: Upon the resumption of normal power, the DDC panel shall analyze the status of all controlled equipment, compare it with normal occupancy scheduling, and turn equipment on or off as necessary to resume normal operation.
- C. Energy Management Applications: DDC Panels shall have the ability to perform any or all of the following energy management routines:
1. Time of Day Scheduling
 2. Calendar Based Scheduling
 3. Holiday Scheduling
 4. Temporary Schedule Overrides
 5. Optimal Start
 6. Optimal Stop
 7. Night Setback Control
 8. Enthalpy Switchover (Economizer)
 9. Peak Demand Limiting
 10. Temperature Compensated Load Rolling
 11. Fan Speed/CFM Control
 12. Heating/Cooling Interlock
 13. Cold Deck Reset

14. Hot Deck Reset
 15. Hot Water Reset
 16. Chilled Water Reset
 17. Condenser Water Reset
 18. Chiller Sequencing
 19. All programs shall be executed automatically without the need for operator intervention, and shall be flexible enough to allow user customization. Programs shall be applied to building equipment as described in the Execution portion of this specification.
- D. Graphical Custom Process Programming Capability: DDC panels shall be able to execute custom, job-specific processes defined by the user, to automatically perform calculations and special control routines.
1. Process Inputs and Variables: It shall be possible to use any of the following in a custom process:
 2. Any system-measured point data or status
 3. Any calculated data
 4. Any results from other processes
 5. User-Defined Constants
 6. Arithmetic functions (+, -, *, /, square root, exp, etc.)
 7. Boolean logic operators (and, or, exclusive or, etc.)
 8. On-delay/Off-delay/One-shot timers
 9. Process Triggers: Custom processes may be triggered based on any combination of the following:
 10. Time interval
 11. Time of day
 12. Date
 13. Other processes
 14. Time programming
 15. Events (e.g., point alarms)

16. Dynamic Data Access: A single process shall be able to incorporate measured or calculated data from any and all other DDC panels on the local area network.

In addition, a single process shall be able to issue commands to points in any and all other DDC panels on the local area network.

17. Advisory/Message Generation: Processes shall be able to generate operator messages and advisories to operator I/O devices. A process shall be able to directly send a message to a specified device, buffer the information in a follow-up file, or cause the execution to a dial-up connection to a remote device such as a printer or pager.

18. Custom Process Documentation: The custom control-programming feature shall be self-documenting. All interrelationships defined by this feature shall be documented via graphic flowcharts and English language descriptors.

- E. Alarm Management: Alarm management shall be provided to monitor, buffer, and direct alarm reports to operator devices and memory files. Each DDC panel shall perform distributed independent alarm analysis and filtering to minimize network traffic, and prevent alarms from being lost. At no time shall the DDC panel's ability to report alarms be affected by either operator activity at a PC Workstation or local I/O device, or communications with other panels on the network.

1. Point Change Report Description: All alarm or point change reports shall include the point's English language description and the time and date of occurrence.
2. Prioritization: The user shall be able to define the specific system reaction for each point. Alarms shall be prioritized to minimize nuisance reporting and to speed operator response to critical alarms. A minimum of three priority levels shall be provided. Each DDC panel shall automatically inhibit the reporting of selected alarms during system shutdown and start-up. Users shall have the ability to manually inhibit alarm reporting for each point.

The user shall also be able to define under which conditions point changes need to be acknowledged by an operator, and/or sent to follow-up files for retrieval and analysis at a later date.

3. Report Routing: Alarm reports, messages, and files will be directed to a user-defined list of operator devices, or PCs used for archiving alarm information. Alarms shall also be automatically directed to a default device in the event a primary device is found to be off-line.
4. Alarm Messages: In addition to the point's descriptor and the time and date, the user shall be able to print, display or store a 65-character alarm message to more fully describe the alarm condition or direct operator response.

Each standalone DDC panel shall be capable of storing a library of at least 250 Alarm Messages. Each message may be assignable to any number of points in the panel.

5. Auto-Dial Alarm Management: In Dial-up applications, only critical alarms shall initiate a call to a remote operator device. In all other cases, call activity shall be minimized by time-stamping and saving reports until an operator scheduled time, a manual request, or until the buffer space is full. The alarm buffer must store a minimum of 50 alarms.
- F. Historical Data and Trend Analysis: A variety of Historical data collection utilities shall be provided to automatically sample, store, and display system data in all of the following ways.
1. Continuous Point Histories: Standalone DDC panels shall store Point History Files for all analog and binary inputs and outputs.

The Point History routine shall continuously and automatically sample the value of all analog inputs at half-hour intervals. Samples for all points shall be stored for the past 24 hours to allow the user to immediately analyze equipment performance and all problem-related events for the past day. Point History Files for binary input or output points and analog output points shall include a continuous record of the last ten status changes or commands for each point.
 2. Control Loop Performance Trends: Standalone DDC panels shall also provide high resolution sampling capability with an operator-adjustable resolution of 10-300 seconds in one-second increments for verification of control loop performance.
 3. Extended Sample Period Trends: Measured and calculated analog and binary data shall also be assignable to user-definable trends for the purpose of collecting operator-specified performance data over extended periods of time. Sample intervals of 1 minute to 2 hours, in one-minute intervals, shall be provided. Each standalone DDC panel shall have a dedicated buffer for trend data, and shall be capable of storing a minimum of 5000 data samples.
 4. Data Storage and Archiving: Trend data shall be stored at the Standalone DDC panels, and uploaded to hard disk storage when archival is desired. Uploads shall occur based upon either: user-defined intervals, manual command, or when the trend buffers become full. All trend data shall be available in disk file form for use in 3rd Party personal computer applications.
- G. Runtime Totalization: Standalone DDC panels shall automatically accumulate and store runtime hours for binary input and output points as specified in the Execution portion of this specification.
1. The Totalization routine shall have a sampling resolution of one minute or less.
 2. The user shall have the ability to define a warning limit for Runtime Totalization. Unique, user-specified messages shall be generated when the limit is reached.
- H. Analog/Pulse Totalization: Standalone DDC panels shall automatically sample, calculate and store consumption totals on a daily, weekly, or monthly basis for user-selected analog and binary pulse input-type points.
1. Totalization shall provide calculation and storage of accumulations of up to 99,999.9 units (e.g. KWH, gallons, KBTU, tons, etc.).

2. The Totalization routine shall have a sampling resolution of one minute or less.
 3. The user shall have the ability to define a warning limit. Unique, user-specified messages shall be generated when the limit is reached.
- I. Event Totalization: Standalone DDC panels shall have the ability to count events such as the number of times a pump or fan system is cycled on and off. Event totalization shall be performed on a daily, weekly, or monthly basis.
1. The Event Totalization feature shall be able to store the records associated with a minimum of 9,999,999 events before reset.
 2. The user shall have the ability to define a warning limit. Unique, user-specified messages shall be generated when the limit is reached.

2.11 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. Unitary Controllers:
 - a. Unitary Controllers shall support, but not be limited to, the following types of systems to address specific applications described in the Execution portion of this specification, and for future expansion:
 - 1) Fan Coils (Two-Pipe, Four-Pipe)
 - b. Unitary Controllers shall support the following types of point inputs and outputs:
 - 1) Heating and Cooling Outputs
 - a) 1 to 3 Stages
 - b) Analog Output with two-pipe logic
 - c) Reversing valve logic for Heat Pumps
 - 2) Fan Output
 - a) On/Off Logic Control
 - c. Unitary controllers shall support the following library of control strategies to address the requirements of the sequences described in the Execution portion of this specification, and for future expansion:
 - 1) Daily/Weekly Schedules
 - 2) Comfort/Occupancy Mode
 - 3) Economy Mode
 - a) Standby Mode/Economizer Available
 - b) Unoccupied/Economizer Not Available
 - c) Shutdown

- 4) Temporary Override Mode
 - a) Temporary Comfort Mode (Occupancy-Based Control)
 - b) Boost (Occupant Warmer/Cooler Control)
 - d. Occupancy-Based Standby/Comfort Mode Control: Each Unitary 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 Unitary 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 Unitary 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 Unitary Controller shall perform its own limit and status monitoring and analysis to maximize network performance by reducing unnecessary communications.
- I. Wireless Monitoring
- 1. This Section shall provide wireless interfaces on systems and medical equipment where indicated in the contract documents
 - 2. The wireless technology shall be compatible with all other wireless technologies employed in the hospital and shall be submitted for review and approval. The wireless technology shall also operate over the UCDCM data network wireless access points installed throughout the hospital by the UCDCM IT department.
 - 3. Coordinate monitoring requirements and installation details for the medical equipment with the University equipment planner.

PART 3 - EXECUTION

3.01 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 16.
 - 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 16 unless specifically indicated otherwise on the Drawings.

3.02 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.

3.03 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.

3.04 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.
6. System endurance test.
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.
16. Review and document system architecture.

3.05 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 230923

SECTION 23 31 13

METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Single-wall rectangular ducts and fittings.
 - 2. Single-wall round and flat-oval ducts and fittings.
 - 3. Sheet metal materials.
 - 4. Sealants and gaskets.
 - 5. Hangers and supports.
 - 6. Seismic-restraint devices.
- 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"
- B. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in **ASCE 7 Section 13.6 as modified by the CBC 2019 Section 1617A. For structurally braced supports systems, refer to Mason West, Inc. Seismic Restraint Guidelines for Suspended Distribution Systems, OPM-0043-13.**
 - 1. Seismic Hazard Level A: Seismic force to weight ratio, 0.48.
 - 2. Seismic Hazard Level B: Seismic force to weight ratio, 0.30.
 - 3. Seismic Hazard Level C: Seismic force to weight ratio, 0.15.
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

1.4 SUBMITTALS

- A. Product Data: For each type of the following products:
 - 1. Liners and adhesives.
 - 2. Sealants and gaskets.
 - 3. Seismic-restraint devices.
- B. Shop Drawings:

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DT1 #1745B CATH LAB REPLACE X-RAY EQUIPMENT
PROJECT NO. 9557230

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
 2. Factory- and shop-fabricated ducts and fittings.
 3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
 4. Elevation of top of ducts.
 5. Dimensions of main duct runs from building grid lines.
 6. Fittings.
 7. Reinforcement and spacing.
 8. Seam and joint construction.
 9. Penetrations through fire-rated and other partitions.
 10. Equipment installation based on equipment being used on Project.
 11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
 12. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.
- C. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
 2. Suspended ceiling components.
 3. Structural members to which duct will be attached.
 4. Size and location of initial access modules for acoustical tile.
 5. Penetrations of smoke barriers and fire-rated construction.
 6. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. Perimeter moldings.
 - g.
- D. Welding certificates.
- E. Field quality-control reports.
- 1.5 QUALITY ASSURANCE
- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports, AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
 2. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."
- D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, 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 1-4, "Transverse (Girth) 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 1-5, "Longitudinal Seams - Rectangular Ducts," 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 2, "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 AND FLAT-OVAL DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
 - 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. Lindab Inc.
 - b. McGill AirFlow LLC.
 - c. SEMCO Incorporated.
 - d. Sheet Metal Connectors, Inc.
 - e. Spiral Manufacturing Co., Inc.
 - f. Or approved equal.
- B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).
- C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," 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.

- D. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," 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.
- E. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "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.
 - 1. Galvanized Coating Designation: G90.
 - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.
- D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.
- E. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.
- F. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
 - 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- G. 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.

2.4 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:
 - 1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
 - 2. Tape Width: 4 inches.

3. Sealant: Modified styrene acrylic.
 4. Water resistant.
 5. Mold and mildew resistant.
 6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 7. Service: Indoor and outdoor.
 8. Service Temperature: Minus 40 to plus 200 deg F.
 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
 10. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Water-Based Joint and Seam Sealant:
1. Application Method: Brush on.
 2. Solids Content: Minimum 65 percent.
 3. Shore A Hardness: Minimum 20.
 4. Water resistant.
 5. Mold and mildew resistant.
 6. 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. 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.
 3. Solvent: Toluene and heptane.
 4. Solids Content: Minimum 60 percent.
 5. Shore A Hardness: Minimum 60.
 6. Water resistant.
 7. Mold and mildew resistant.
 8. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 9. 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".
 10. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
 11. Service: Indoor or outdoor.
 12. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- E. Flanged Joint Sealant: Comply with ASTM C 920.
1. General: Single-component, acid-curing, silicone, elastomeric.
 2. Type: S.
 3. Grade: NS.
 4. Class: 25.
 5. Use: O.
 6. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- 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:
 1. **For gravity, non-structural supports:** Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."
 2. For structurally braced supports systems, refer to Mason West, Inc. Seismic Restraint Guidelines for Suspended Distribution Systems, OPM-0043-13.
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

2.6 SEISMIC-RESTRAINT DEVICES

- 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. Cooper B-Line, Inc.; a division of Cooper Industries.
 2. Ductmate Industries, Inc.
 3. Hilti Corp.
 4. Kinetics Noise Control.
 5. Loos & Co.; Cableware Division.
 6. Mason Industries.
 7. TOLCO; a brand of NIBCO INC.
 8. Unistrut Corporation; Tyco International, Ltd.
- 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.
 1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

- C. Channel Support System: 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 or ASTM A 492, stainless-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 or Reinforcing steel angle clamped 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 and flat-oval 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.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."

3.2 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
 - 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 2. Outdoor, Supply-Air Ducts: Seal Class A.
 - 3. Outdoor, Exhaust Ducts: Seal Class 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.

3.4 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."

- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
 - 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 SEISMIC-RESTRAINT-DEVICE INSTALLATION

- A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with ASCE/SEI 7.
- B. Select seismic-restraint devices with capacities adequate to carry present static and seismic loads.
- C. Install cables so they do not bend across edges of adjacent equipment or building structure.
- D. Install cable restraints on ducts that are suspended with vibration isolators.
- E. Install seismic-restraint devices using methods approved by the Office of Statewide Health Planning and Development for the State of California.
- F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.
- G. Drilling for and Setting Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.

4. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.6 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.

3.7 PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09 painting Sections.

3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Leakage Tests:
 1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
 2. Test the following systems - Supply duct mains prior to CAV/VAV branches, as well as all ducts in shafts or where duct will be inaccessible:
 - a. Ducts with a Pressure Class Higher Than 3-Inch wg: Test representative duct sections, selected by Construction Manager from sections installed, totaling no less than 25 percent of total installed duct area for each designated pressure class.
 - b. Supply Ducts with a Pressure Class of 3-Inch wg or Higher: Test representative duct sections, selected by Construction Manager from sections installed, totaling no less than 50 percent of total installed duct area for each designated pressure class.
 - c. Return Ducts with a Pressure Class of 3-Inch wg or Higher: Test representative duct sections, selected by Construction Manager from sections installed, totaling no less than 50 percent of total installed duct area for each designated pressure class.
 - d. Exhaust Ducts with a Pressure Class of 3-Inch wg or Higher: Test representative duct sections, selected by Construction Manager from sections installed, totaling no less than 50 percent of total installed duct area for each designated pressure class.
 - e. Outdoor Air Ducts with a Pressure Class of 3-Inch wg or Higher: Test representative duct sections, selected by Construction Manager from sections installed, totaling no less than 50 percent of total installed duct area for each designated pressure class.
 3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
 4. Test for leaks before applying external insulation.
 5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
 6. Give seven days' advance notice for testing.
- C. Duct System Cleanliness Tests: Note – Ducts shall be shop fabricated with sealed ends installed after shop cleaning. Ducts shall be installed on site with ends sealed daily and all open ends closed including registers until construction is complete. A visual inspection and cleaning shall be required if damage is found or suspected during field installation.

1. Visually inspect duct system to ensure that no visible contaminants are present.
2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
 - a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.9 DUCT CLEANING

A. Cleaning shall be required only for duct sections that has been found or suspected to be damaged during installation.

B. Use service openings for entry and inspection.

1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Division 23 Section "Air Duct Accessories" for access panels and doors.
2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

D. Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.

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4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.10 START UP

- A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.11 DUCT SCHEDULE

- A. Supply Ducts:
 1. Ducts Connected to Variable-Volume Air-Handling Units:
 - a. Pressure Class: Positive 3-inch wg.
 - b. Minimum SMACNA Seal Class: B.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round and Flat Oval: 6.
- B. Return Ducts:
 1. Ducts Connected to Air-Handling Units:
 - a. Pressure Class: Positive or negative 3-inch wg.
 - b. Minimum SMACNA Seal Class: B.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round and Flat Oval: 6.
- C. Exhaust Ducts:
 1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
 - a. Pressure Class: Negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: C if negative pressure, and A if positive pressure.
 - c. SMACNA Leakage Class for Rectangular: 24.
 - d. SMACNA Leakage Class for Round and Flat Oval: 12.
- D. Intermediate Reinforcement:
 1. Galvanized-Steel Ducts: Galvanized steel or carbon steel coated with zinc-chromate primer.
- E. Elbow Configuration:
 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "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 2-3, "Vanes and Vane Runners," and Figure 2-4, "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 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
- 2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "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.
 - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
 - c. Round Elbows, 14 Inches and Larger in Diameter: Welded.
- F. Branch Configuration:
 - 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."
 - 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 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "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:

1. Backdraft and pressure relief dampers.
2. Barometric relief dampers.
3. Manual volume dampers.
4. Control dampers.
5. Fire dampers.
6. Ceiling dampers.
7. Smoke dampers.
8. Combination fire and smoke dampers.
9. Corridor dampers.
10. Flange connectors.
11. Duct silencers.
12. Turning vanes.
13. Remote damper operators.
14. Duct-mounted access doors.
15. Flexible connectors.
16. Flexible ducts.
17. Duct security bars.
18. Duct accessory hardware.

B. Related Sections:

1. Division 28 Section "Fire Detection and Alarm" for duct-mounted fire and smoke detectors.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
 1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.
- B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
 1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
 - a. Special fittings.
 - b. Manual volume damper installations.
 - c. Control damper installations.
 - d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
 - e. Duct security bars.

PART 2 - Retain subparagraph below if equipment includes wiring.

- a. Wiring Diagrams: For power, signal, and control wiring.
- B. 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.
- C. Source quality-control reports.
- D. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

2.2 QUALITY ASSURANCE

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with AMCA 500-D testing for damper rating.

2.3 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. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 3 - PRODUCTS

3.1 MATERIALS

- A. 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.
 - 1. Galvanized Coating Designation: G90.
 - 2. Exposed-Surface Finish: Mill phosphatized.
- C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and a No. 1 finish for exposed ducts.
- D. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- E. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

3.2 BACKDRAFT AND PRESSURE RELIEF DAMPERS

- 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. Greenheck Fan Corporation.
 - 2. Nailor Industries Inc.
 - 3. Pottorff; a division of PCI Industries, Inc.
 - 4. Ruskin Company.
- B. Description: Gravity balanced.
- C. Maximum Air Velocity: 2000 fpm.
- D. Maximum System Pressure: 1-inch wg.
- E. Frame: 0.052-inch- thick, galvanized sheet steel, with welded corners and mounting flange unless otherwise noted in equipment schedules.
- F. Blades: Multiple single-piece blades, center-pivoted, maximum 6-inch width, 0.025-inch- thick, roll-formed aluminum with sealed edges.
- G. Blade Action: Parallel.
- H. Blade Seals: Extruded vinyl, mechanically locked.

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- I. Blade Axles:
 - 1. Material: Stainless steel.
 - 2. Diameter: 0.20 inch.
- J. Tie Bars and Brackets: Galvanized steel.
- K. Return Spring: Adjustable tension.
- L. Bearings: Steel ball or synthetic pivot bushings.
- M. Accessories:
 - 1. Adjustment device to permit setting for varying differential static pressure.
 - 2. Counterweights and spring-assist kits for vertical airflow installations.
 - 3. Electric actuators.
 - 4. Chain pulls.
 - 5. Screen Mounting: Front mounted in sleeve.
 - a. Sleeve Thickness: 20-gage minimum.
 - b. Sleeve Length: 6 inches minimum.
 - 6. Screen Mounting: Rear mounted.
 - 7. Screen Material: Galvanized steel.
 - 8. Screen Type: Insect.
 - 9. 90-degree stops.

3.3 BAROMETRIC RELIEF DAMPERS

- 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. Greenheck Fan Corporation.
 - 2. Nailor Industries Inc.
 - 3. Pottorff; a division of PCI Industries, Inc.
 - 4. Ruskin Company.
- B. Suitable for horizontal or vertical mounting.
- C. Maximum Air Velocity: 2000 fpm.
- D. Maximum System Pressure: 2-inch wg.

E. Frame: 0.064-inch- thick, galvanized sheet steel, with welded corners and mounting flange.

F. Blades:

1. Multiple, 0.025-inch- thick, roll-formed aluminum.
2. Maximum Width: 6 inches.
3. Action: Parallel.
4. Balance: Gravity.
5. Eccentrically pivoted.

G. Blade Seals: Vinyl.

H. Blade Axles: Galvanized steel.

I. Tie Bars and Brackets:

1. Material: Aluminum.
2. Rattle free with 90-degree stop.

J. Return Spring: Adjustable tension.

K. Bearings: Synthetic.

L. Accessories:

1. Flange on intake.
2. Adjustment device to permit setting for varying differential static pressures.

3.4 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

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. METALAIRE, Inc.
 - b. Nailor Industries Inc.
 - c. Pottorff; a division of PCI Industries, Inc.
 - d. Ruskin Company.
2. Standard leakage rating, with linkage outside airstream.
3. Suitable for horizontal or vertical applications.
4. Frames:

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- a. Hat-shaped, galvanized or stainless-steel channels, 0.064-inch minimum thickness.
 - 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.
- 6. Blade Axles: Stainless steel.
- 7. Bearings:
 - a. Molded synthetic.
 - 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.
- 9.
- B. Low-Leakage, Steel, Manual Volume Dampers:
 - 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. METALAIR, Inc.
 - b. Nailor Industries Inc.
 - c. Pottorff; a division of PCI Industries, Inc.
 - d. Ruskin Company.
 - 2. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
 - 3. Suitable for horizontal or vertical applications.
 - 4. Frames:
 - a. Hat shaped.
 - b. Galvanized or Stainless-steel channels, 0.064 inch thick.
 - c. Mitered and welded corners.
 - d. 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, roll-formed steel, 0.064 inch thick.

6. Blade Axles: Galvanized steel.
7. Bearings:
 - a. Molded synthetic.
 - 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. Blade Seals: Vinyl.
9. Jamb Seals: Cambered stainless steel.
10. Tie Bars and Brackets: Galvanized steel.
11. Accessories:
 - a. Include locking device to hold single-blade dampers in a fixed position without vibration.

3.5 CONTROL DAMPERS

- 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. Greenheck Fan Corporation.
 2. METALAIRE, Inc.
 3. Nailor Industries Inc.
 4. Ruskin Company.
- B. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
- C. Frames:
 1. Hat shaped.
 2. Galvanized or Stainless-steel channels, 0.064 inch thick.
 3. Mitered and welded corners.
- D. Blades:
 1. Multiple blades with maximum blade width of 8 inches.
 2. Parallel- and opposed-blade design.
 3. Galvanized or Stainless steel.
 4. 0.064 inch thick.

- 5. Blade Edging: Closed-cell neoprene edging.
- 6. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.
- E. Blade Axles: 1/2-inch- diameter; stainless steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.
 - 1. Operating Temperature Range: From minus 40 to plus 200 deg F.
- F. Bearings:
 - 1. Molded synthetic.
 - 2. 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.
 - 3. Thrust bearings at each end of every blade.

3.6 FIRE DAMPERS

- 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. Greenheck Fan Corporation.
 - 2. METALAIR, Inc.
 - 3. Nailor Industries Inc.
 - 4. Pottorff; a division of PCI Industries, Inc.
 - 5. Ruskin Company.
- B. Type: Static and dynamic; rated and labeled according to UL 555 by an NRTL.
- C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 4000-fpm velocity.
- D. Fire Rating: 1-1/2 and 3 hours.
- E. Frame: Curtain type with blades outside airstream except when located behind grille where blades may be inside airstream; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.
- F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
 - 1. Minimum Thickness: 0.052 or 0.138-inch-thick, as indicated, and of length to suit application.
 - 2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.
- G. Mounting Orientation: Vertical or horizontal as indicated.

- H. Blades: Roll-formed, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.
- I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
- J. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

3.7 CEILING DAMPERS

- 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. METALAIRE, Inc.
 - 2. Nailor Industries Inc.
 - 3. Prefco; Perfect Air Control, Inc.
 - 4. Ruskin Company.
- B. General Requirements:
 - 1. Labeled according to UL 555C by an NRTL.
 - 2. Comply with construction details for tested floor- and roof-ceiling assemblies as indicated in UL's "Fire Resistance Directory."
- C. Frame: Galvanized sheet steel, round or rectangular, style to suit ceiling construction.
- D. Blades: Galvanized sheet steel with refractory insulation.
- E. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.
- F. Fire Rating: 2 hours.

3.8 SMOKE DAMPERS

- 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. Ruskin Company.
 - 2. Greenheck Fan Corporation.
 - 3. Nailor Industries Inc.
 - 4. PHL, Inc.
- B. General Requirements: Label according to UL 555S by an NRTL.
- C. Damper Actuation: Damper actuation shall be in accordance with Sections 716.3.3.1 through 716.3.3.4 of the 2010 California Building Code as applicable.

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- D. Frame: Frame shall be a minimum of 0.125 inch aluminum formed into a structural hat channel shape with corner braces for reinforcement.
- E. Blades: Blades shall be aluminum airfoil shaped single piece construction. Standard blade action shall be parallel.
- F. Blade Edge Seals: Blade edge seals shall be silicone rubber designed to withstand 450 ° F and jamb seals shall be aluminum flexible metal compression type.
- G. Bearings: Bearings shall be stainless steel sleeve turning in an extruded hole in the frame.
- H. Leakage: Class I (4 CFM/sq. ft. at 1.0 inch w.g.).
- I. Rated pressure and velocity: As part of the UL qualification, damper shall have demonstrated a capacity to operate (to open and close) under HVAC system operating conditions, with pressures up to 4 inch w.g. in the closed position, and 4,000 fpm air velocity in the open position.
- J. Mounting Sleeve: Factory-installed, 0.052-inch- thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone calking.
- K. Damper Motors: Modulating or two-position action.
- L. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 - 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 23 Section "Instrumentation and Control for HVAC" and Division 26 Sections.
 - 3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
 - 4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
 - 5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
 - 6. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
 - 7. Electrical Connection: 115 V, single phase, 60 Hz.
- M. Accessories:

1. Each smoke damper shall be equipped with Ruskin SP100 Switch Package or equal. The Switch Package shall include two position indicator switches linked directly to the damper blade to provide the capacity of remotely indicating blade position.

3.9 COMBINATION FIRE AND SMOKE DAMPERS

- 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. Ruskin Company.
 2. Air Balance Inc.; a division of Mestek, Inc.
 3. Cesco Products; a division of Mestek, Inc.
 4. Greenheck Fan Corporation.
 5. Nailor Industries Inc.
- B. Type: Static and dynamic; rated and labeled according to UL 555 and UL 555S by an NRTL.
- C. Damper Actuation: Damper actuation shall be in accordance with Sections 716.3.3.1 through 716.3.3.4 of the 2010 California Building Code as applicable.
- D. Closing rating in ducts up to 4-inch wg static pressure class and minimum 4000-fpm velocity.
- E. Fire Rating: 1-1/2 and 3 hours.
- F. Frame: Frame shall be a minimum of 16-gauge galvanized steel formed into a structural hat channel reinforced at corners for added strength.
- G. Heat-Responsive Device: Electric resettable link and switch package, factory installed, rated.
- H. Blades: Blades shall be airfoil shaped double skin construction with 14-gauge equivalent thickness.
- I. Bearings: Bearings shall be stainless steel turning in an extruded hole in the frame.
- J. Blade Edge Seals: Blade edge seals shall be silicone rubber and galvanized steel mechanically locked into blade edge and shall withstand a minimum of 450 ° F.
- K. Jamb Seals: Jamb seals shall be non-corrosive stainless-steel flexible metal compression type.
- L. Leakage: Class I (4 cfm/sq. ft. at 1-inch w.g. and 8 cfm/sq. ft. at 4 inch w.g.).
- M. Rated pressure and velocity: As part of the UL qualification, dampers shall have demonstrated a capacity to operate (to open and close) under HVAC system operating conditions, with pressures of at least 4 inches w.g. in the closed position and up to 4,000 fpm air velocity in the open position.
- N. Mounting Sleeve: Factory-installed, 0.052-inch- thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone calking.
- O. Master control panel for use in dynamic smoke-management systems.

- P. Damper Motors: Modulating or two-position action.
- Q. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 - 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 23 Section "Instrumentation and Control for HVAC" and Division 26 Sections.
 - 3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
 - 4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
 - 5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
 - 6. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
 - 7. Electrical Connection: 115 V, single phase, 60 Hz.
- R. Accessories:
 - 1. Each smoke damper shall be equipped with Ruskin SP100 Switch Package or equal. The Switch Package shall include two position indicator switches linked directly to the damper blade to provide the capacity of remotely indicating blade position.

3.10 CEILING DIFFUSER COMBINATION FIRE SMOKE RADIATION DAMPERS

- 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. Ruskin Company.
 - 2. Air Balance Inc.; a division of Mestek, Inc.
 - 3. Cesco Products; a division of Mestek, Inc.
 - 4. Nailor Industries Inc.
- B. General Requirements:
 - 1. Label combination fire and smoke dampers according to UL 555 for 1-1/2-hour rating by an NRTL.

2. Label combination fire and smoke dampers according to UL 555S for smoke damper rating by an NRTL and label Leakage Class I.
 3. Label combination fire and smoke dampers according to UL 555C as a ceiling damper.
 4. California State Fire Marshall Listed.
- C. Controlled Closure Device (Heat Activated): 165° F standard. Electric EFL standard with electric actuator.
- D. Frame: 20-gauge galvanized steel, 10-inch depth.
- E. Blades: 20-gauge galvanized steel.
- F. Bearings: Stainless steel sleeve, pressed into frame.
- G. Blade Seal: Silicone edge type for smoke seal to 450° F.
- H. Axles: ½ inch plated steel.
- I. Damper Finish: Mill galvanized.
- J. Diffuser Finish: Standard white.
- K. Thermal Blanket Insulation: Mineral wool standard.
- L. Mounting: Horizontal in T-bar or rigid (gypboard) ceiling.
- M. Diffuser Type and Size: Perforated surface mount. 24" x 24" nominal. 22-gauge steel.
- 3.11 CORRIDOR DAMPERS
- 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. Air Balance Inc.; a division of Mestek, Inc.
 2. Cesco Products; a division of Mestek, Inc.
 3. Nailor Industries Inc.
 4. Ruskin Company.
- B. General Requirements: Label combination fire and smoke dampers according to UL 555 for 1-1/2-hour rating by an NRTL.
- C. Heat-Responsive Device: Electric resettable link and switch package, factory installed, rated.
- D. Frame: Frame shall be a minimum of 16 gauge galvanized steel formed into a structural hat channel reinforced at corners for added strength.
- E. Blades: Roll-formed, horizontal, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.

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- F. Mounting Sleeve: Factory-installed, 0.052-inch- thick, galvanized sheet steel; length to suit wall or floor application.
- G. Damper Motors: Modulating or two-position action.
- H. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 - 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 23 Section "Instrumentation and Control for HVAC." And Division 26 Sections.
 - 3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
 - 4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
 - 5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
 - 6. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
 - 7. Electrical Connection: 115 V, single phase, 60 Hz.

3.12 FLANGE CONNECTORS

- 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. Ductmate Industries, Inc.
 - 2. Nexus PDQ; Division of Shilco Holdings Inc.
 - 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
 - 4. Or approved equal.
- B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Galvanized steel.
- D. Gage and Shape: Match connecting ductwork.

3.13 TURNING VANES

- 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. Ductmate Industries, Inc.
 - 2. Duro Dyne Inc.
 - 3. METALAIRE, Inc.
 - 4. SEMCO Incorporated.
 - 5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
- C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."
- D. Vane Construction: Double wall.

3.14 REMOTE DAMPER OPERATORS

- 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. Pottorff; a division of PCI Industries, Inc.
 - 2. Ventfabrics, Inc.
 - 3. Young Regulator Company.
 - 4. Or approved equal..
- B. Description: Cable system designed for remote manual damper adjustment.
- C. Tubing: Brass.
- D. Cable: Stainless steel.
- E. Wall-Box Mounting: Recessed, 2 inches deep.
- F. Wall-Box Cover-Plate Material: Stainless steel.

3.15 DUCT-MOUNTED ACCESS DOORS

- 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. Ductmate Industries, Inc.

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2. Flexmaster U.S.A., Inc.
 3. Greenheck Fan Corporation.
 4. Nailor Industries Inc.
 5. Pottorff; a division of PCI Industries, Inc.
- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-10, "Duct Access Doors and Panels," and 2-11, "Access Panels - Round Duct."
1. Door:
 - a. Double wall, rectangular.
 - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
 - c. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
 - d. 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: Two hinges and two sash locks.
 - c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
 - d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.
- C. Pressure Relief Access Door:
1. Door and Frame Material: Galvanized sheet steel.
 2. Door: Double wall with insulation fill with metal thickness applicable for duct pressure class.
 3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.
 4. Factory set at 10-inch wg.
 5. Doors close when pressures are within set-point range.
 6. Hinge: Continuous piano.
 7. Latches: Cam.
 8. Seal: Neoprene or foam rubber.
 9. Insulation Fill: 1-inch- thick, fibrous-glass or polystyrene-foam board.

3.16 FLEXIBLE CONNECTORS

- 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. Ductmate Industries, Inc.
 - 2. Duro Dyne Inc.
 - 3. Ventfabrics, Inc.
 - 4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.
 - 1. Provide coatings and adhesives for use inside the weatherproofing system that comply with the limits for VOC content when calculated according to 40 CFR 59, Part 59, Subpart D (EPA Method 24) identified in Section 018113.
- D. Metal-Edged Connectors: Factory fabricated with a fabric strip 5-3/4 inches wide attached to 2 strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.
- E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
 - 1. Minimum Weight: 26 oz./sq. yd..
 - 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
 - 3. Service Temperature: Minus 40 to plus 200 deg F.
- F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
 - 1. Minimum Weight: 24 oz./sq. yd..
 - 2. Minimum Tensile Strength: 500 lbf/inch in the warp and 440 lbf/inch in the filling.
 - 3. Service Temperature: Minus 50 to plus 250 deg F.
- G. High-Temperature System, Flexible Connectors: Glass fabric coated with silicone rubber.
 - 1. Minimum Weight: 16 oz./sq. yd..
 - 2. Tensile Strength: 285 lbf/inch in the warp and 185 lbf/inch in the filling.
 - 3. Service Temperature: Minus 67 to plus 500 deg F.
- H. High-Corrosive-Environment System, Flexible Connectors: Glass fabric with chemical-resistant coating.

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1. Minimum Weight: 14 oz./sq. yd..
 2. Tensile Strength: 450 lbf/inch in the warp and 340 lbf/inch in the filling.
 3. Service Temperature: Minus 67 to plus 500 deg F.
- I. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.
1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
 2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
 7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

3.17 FLEXIBLE DUCTS

- 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. Flexmaster U.S.A., Inc.
 2. McGill AirFlow LLC.
 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
 4. Alco Rubber Products.
 5. Or approved equal.
- B. Noninsulated, Flexible Duct: UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound, spring-steel wire.
1. Pressure Rating: 10-inch wg positive per UL-181 and 0.75-inch wg negative.
 2. Maximum Air Velocity: 4000 fpm.
 3. Temperature Range: Minus 20 to plus 250 deg F Intermittent (@ ½ inch positive w.g. max); Minus 20 to 180 deg F Continuous (@ 2 inch positive w.g. max); Minus 20 to 140 deg F Continuous (@ maximum pressure).

- C. Insulated, Flexible Duct: UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.
1. Pressure Rating: 10-inch wg positive per UL-181 and 0.75 -inch wg negative.
 2. Maximum Air Velocity: 4000 fpm.
 3. Temperature Range: Minus 20 to plus 250 deg F Intermittent (@ ½ inch positive w.g. max); Minus 20 to 180 deg F Continuous (@ 2 inch positive w.g. max); Minus 20 to 140 deg F Continuous (@ maximum pressure).
 4. Insulation R-value: Comply with ASHRAE/IESNA 90.1-2004.
- D. Flexible Duct Connectors:
1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.
 2. Non-Clamp Connectors: Adhesive plus sheet metal screws.

3.18 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 4 - EXECUTION

4.1 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 backdraft or control dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. 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.

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- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Install test holes at fan inlets and outlets and elsewhere as indicated.
- G. Install fire and smoke dampers according to UL listing.
- H. Connect ducts to duct silencers with flexible duct connectors.
- I. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - 1. On upstream side of duct coils.
 - 2. At drain pans and seals.
 - 3. 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.
 - 4. Control devices requiring inspection.
 - 5. Elsewhere as indicated.
- J. Install access doors with swing against duct static pressure.
- K. Access Door Sizes:
 - 1. One-Hand or Inspection Access: 8 by 5 inches.
 - 2. Two-Hand Access: 12 by 6 inches.
 - 3. Head and Hand Access: 18 by 10 inches.
 - 4. Head and Shoulders Access: 21 by 14 inches.
 - 5. Body Access: 25 by 14 inches.
 - 6. Body plus Ladder Access: 25 by 17 inches.
- L. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- M. Install flexible connectors to connect ducts to equipment.
- N. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- O. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
- P. Connect diffusers or light troffer boots to ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.

- Q. Connect flexible ducts to metal ducts with draw bands.
- R. Install duct test holes where required for testing and balancing purposes.

4.2 FIELD QUALITY CONTROL

- A. Tests and Inspections: Contractor to coordinate testing and inspections with the commissioning requirements identified in Section 230800 "Commissioning of HVAC". Test and Inspections (EXCEPT FOR FSD's) can be performed at time of installation.
 - 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 37 13
DIFFUSERS, REGISTERS, & GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Rectangular and square ceiling diffusers.
 - 2. Perforated diffusers.
- B. Related Sections:
 - 1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated, include the following:
 - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
 - 2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.
- B. Samples for Initial Selection: For diffusers, registers, and grilles with factory-applied color finishes.
- C. Samples for Verification: For diffusers, registers, and grilles, in manufacturer's standard sizes to verify color selected.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
 - 1. Ceiling suspension assembly members.
 - 2. Method of attaching hangers to building structure.
 - 3. Size and location of initial access modules for acoustical tile.
 - 4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
 - 5. Duct access panels.
- B. Source quality-control reports.

PART 2 - PRODUCTS

2.1 CEILING DIFFUSERS

A. Rectangular and Square Ceiling Diffusers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Nailor Industries Inc.
 - b. Price Industries.
 - c. Titus.
 - d. Tuttle & Bailey.
 - e. Or approved equal
2. Devices shall be specifically designed for variable-air-volume flows.
3. Material: Steel
4. Finish: Baked enamel, white
5. Face Size: 24 by 24 inches
6. Face Style: Modular core, 4-way discharge
7. Mounting: T-bar
8. Pattern: Adjustable

B. Perforated Diffuser:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Nailor Industries Inc.
 - b. Price Industries.
 - c. Titus.
 - d. Tuttle & Bailey.
 - e. Or approved equal
2. Devices shall be specifically designed for variable-air-volume flows.
3. Material: Steel backpan and pattern controllers, with steel face.
4. Finish: Baked enamel.
5. Face Size: 24 by 24 inches
6. Duct Inlet: Square
7. Mounting: T-bar

2.2 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- 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 25 55 00

GENERAL PROVISIONS FOR BUILDING AUTOMATION SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work included in this Section:

1. The Building Automation System (BAS) manufacturer shall provide the Building Automation System as specified herein in its entirety.
2. The Building Automation System Contractor shall provide the systems covered by this section and have full responsibility for the entire BAS including complete and seamless integration into the UC Davis Medical Center's Johnson Controls, JCI, application data servers over the campus network.
3. It is the intent of this specification for the BAS to be installed as a complete package by the Building Automation System Contractor. The system shall include all necessary and required software and hardware including but not limited to operator interfaces, input/output devices and sensors, controllers, communication equipment and IT infrastructure. Installation, supervision and project management are included as well.
4. The backbone BAS IT infrastructure consisting of CAT6A, patch panels, core switches, switches and media converters will be provided and installed by the University. Devices required to connect to the owner's network will be provided by the BAS contractor. Local switches in each room/panel shall be DIN-rail mountable type.
5. The BAS is a building wide system that incorporates other sub systems, such as HVAC systems direct digital control, DDC, building lighting control interface, energy metering, and packaged equipment controller interface as indicated
6. Control systems using wireless technology and / or cloud base data gathering are not acceptable.
7. All BAS control setpoints shall be accessible by campus JCI servers.
8. 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.

B. Major Items of Work

1. Section 25 55 00 – General Provisions for Building Automation System
2. Section 25 55 20 – Direct Digital Control System and User Interface
3. Section 25 55 30 – Electronic Sensors, Devices and Field Hardware

C. Related Documents:

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1. Drawings and general provisions of the Contract, including General and Supplementary Conditions, applicable portions of Division 1, Division 22, 23 and 26 – Basic Materials and Methods, apply to this Section.
2. Refer to Division-26 sections for power wiring to line-voltage devices and for low voltage wiring and communication wiring to such applicable devices
3. Provide BAS connections to packaged controllers for equipment under Divisions 22 and 23
4. Lighting control integration for new buildings and additions: The BAS scope of work shall include all labor to interface with the Automatic Lighting Controls System provided in Division 26. Refer to Division 26 for complete description of requirements for the Automatic Lighting Control System which shall include hardware gateways BACnet/IP or MSTP to communicate to the BAS.
 - a. Lighting-control contractor shall provide naming matrix, connecting BACnet information/nomenclature to lighting-zone information
5. The BAS scope of work shall include monitoring of other systems and equipment where indicated in the contract documents

1.2 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Building Automation System shall be as manufactured by Johnson Controls and shall carry UL 864 Listing, UUKL classification for smoke control if smoke control is specified.
- B. Electrical Standards: Provide electrical products which have been tested, listed, and labeled by Underwriters Laboratories (U.L.) and comply with NEMA standards.
- C. Installing Contractor Qualifications:
 1. Bids by wholesalers, franchised dealers or any firm whose principal business is not that of manufacturing, developing and installing Building Automation Systems is not acceptable. Bidder must be factory authorized with the product they are proposing.
 2. Firms specializing and experienced in control system installations for not less than 10 years. Firms with experience in DDC installation projects with point counts equal to this project and systems of the same character as this project.
 3. The Building Automation 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
 4. Installing firms submitting as an "approved equal" to JCI Metasys must get pre-approved prior to bid and gain owners acceptance on the following functionality per the Div01 substitution requirement, prior to project bid:
 - a. Installing firm must demonstrate that all BACnet objects are readable from the existing JCI Metasys Building Automation System. Readable BACnet objects

include but not limited to all binary inputs, binary values, binary outputs, analog inputs, analog values, analog outputs, point descriptions, multi-state inputs, multi-state values, multi-state outputs, schedules, trendlogs and alarms.

- b. Installing firm must demonstrate that all BACnet objects are writable from the existing JCI Building Automation System. Writable BACnet objects include but not limited to all binary values, binary outputs, analog values, analog outputs, point descriptions, multi-state values, multi-state outputs, schedules, trendlogs and alarms.
 - c. Installing firm must demonstrate program loaded into any application specific or general-purpose controller must be viewable to the existing Integrated Development Environment (IDE). Firm to demonstrate the ability to upload, edit, save and download programming through the existing JCI system.
 - d. Installing firm must demonstrate that the existing software toolset at the UCDMC servers can make changes to the new application specific controllers. New software will not be allowed.
5. For each point listed above demonstrate that a change in value at the building can be seen by the JCI servers. This change in value must be seen within 30 seconds of value change. There is no exception for this specification requirement. No subsequent BAS submittal packages will be reviewed or accepted until the demonstration is satisfactorily completed with University consent.
6. The Building Automation 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:
- a. Installing Contractor has a contract directly with the factory. A contract with a distributor is not acceptable.
 - b. Installing Contractor has direct access to factory technical support and training
 - c. Installing contractor develops controller hardware and software
7. Any cost impact to the project as a result of the approval process will be the sole responsibility of the installing firm seeking approval. In the event approval is not received installing firm is responsible for any additional costs incurred if an alternate firm is requested to submit.
8. 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).
- D. Installer's Experience with Proposed Product Line:

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1. Firms shall have specialized in and be experienced with the installation of the proposed product line, Metasys for not less than ten years from date of completion on at least three projects of similar size and complexity.

E. Installer's Field Coordinator and Sequence Programmer Qualifications:

1. Individual(s) shall specialize in and be experienced with control system installation for not less than 5 years. Proposed field coordinator shall have experience with the installation of the proposed product line for not less than three projects of similar size and complexity. Installer shall submit the names of the proposed individual and at least one alternate for each duty. Submittals shall document this experience with references. The proposed individuals must show proof of the following training:
 - a. Product Line Training: Individuals overseeing the installation and configuration of the proposed product line must provide evidence of the most advanced training offered by the Manufacturer on that product line for installation and configuration
 - b. Programming Training: Individuals involved with programming the site-specific sequences shall provide evidence of the most advanced programming training offered by the vendor of the programming application offered by the Manufacturer.
 - c. BACnet Training: The BACnet BAS shall be furnished, engineered and installed by individuals who have completed the BACnet Network Design, Installation and Maintenance Training Program. Certifications shall be provided.

F. Installer's Service Qualifications:

1. The installer must be experienced in control system operation, maintenance and service. Installer must document a minimum 5 year history of servicing installations of similar [size] and complexity. Installer must also document at least a one year history of servicing the proposed product line.

G. Installer's Response Time and Proximity

1. Installer must maintain a fully capable service facility within a 45 mile radius of the project site. Service facility shall manage the emergency service dispatches and maintain the inventory of spare parts.

1.3 STANDARDS AND CERTIFICATIONS

A. Sections 25 55 00 to 25 55 60 shall be provided and installed by the same Subcontractor.

B. The entire Building Automation System shall be:

1. Approved and listed by Underwriters Laboratories, Inc. (UL).
2. Listed by State Fire Marshall as an approved Smoke Management System if smoke control is specified.
3. Approved by California Energy Commission as an approved Control and Energy Management System in compliance with California Energy Conservation Code Title 24 requirements.

4. Approved and Listed by the California Energy Commission as an Economizer Fault Detection and Diagnostic (FDD) System.
- C. Listings, Codes and Standards compliance shall include, but not be limited to, the following:
1. Underwriters Laboratories (UL)
 - a. Building Automation System (UL 864 UDTZ).
 - b. Process Management System (UL 864 QUAX).
 - c. Smoke Control Systems Equipment (UL 864 UUKL).
 - d. Energy Management Equipment (UL 916 PAZX).
 2. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 3. National Fire Protection Association (NFPA)
 - a. NFPA 90A
 - b. NFPA 70 (NEC)
 - c. NFPA 92A & 92B
 4. National Electrical Manufacturers Association (NEMA)
 - a. NEMA 250 Enclosure for Electrical Equipment
 - b. NEMA ICS 1: General Standards for Industrial Controls
 5. Electronics Industry Alliance (EIA)
 6. Institute of Electrical and Electronics Engineers (IEEE): IEEE 142: Recommended Practice for Grounding of Industrial and Commercial Power Systems
 7. FCC Part 15, Sub-Part B, Class A
 8. CE Electromagnetic Compatibility
 9. Be registered as meeting appropriate radiated and conducted interference levels from a Class "A" computing device.
- D. Equipment and devices employed in the system shall bear the appropriate UL listing mark to ensure compliance.
- E. The Drawings and specifications are complementary to one another – meaning that what is called for on one is to be considered called for in both. Where conflicts exist between the specification sections or between the specifications and the drawings, the more stringent requirements shall apply.
- F. Where two or more codes conflict, the most restrictive shall apply. Nothing in this specification or related documentation shall be construed to permit work not conforming to applicable codes.

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- G. Specification requirements may exceed any code requirements. Where specifications and code differ or conflict, the most stringent requirement shall apply.

1.4 SUBMITTALS

A. General

1. Conform to requirements of Division 1 and requirements stated herein.
2. Shop drawings and submittals, giving full fitness and other pertinent facts, shall be submitted and approval secured before apparatus in question is ordered, built or installed. The BAS contractor shall be solely responsible for the removal and replacement of any item not in compliance with the contract documents at no cost to the Owner.
3. Shop drawings shall be presented in a manner to facilitate easy visualization of the systems installation and operation.
4. Shop drawings shall be submitted with the following four sections:
 - a. Equipment data sheets and equipment matrix. Valves data sheets and valve selection matrix.
 - b. System architecture, P&I diagrams, wiring and interface diagrams.
 - c. Sequence of operations.
 - d. System Graphics
5. The contractor shall allow a minimum of four weeks of submittal review time by the Architect's for each submittal or re-submittal.
6. The Architect's review of the submittals shall be for general arrangement only and shall not be construed as a complete check or constitute a waiver of the requirements of the Contract Documents.

B. Product Data Sheets

1. Devices and equipment catalogue cuts including specifications and installation instructions for all devices used by the BAS and specified in this division including devices furnished and installed by other Divisions. Indicate proposed application for each device referenced to the applicable specification section.
2. Range and scale information for all transmitters and sensors. Indicate all applicable options and where more than one device is to be used on one sheet, submit a separate, individually marked sheet for each device.
3. Submit a summary matrix listing the following information:
 - a. Rows: Each device
 - b. Columns: Tab#, specification section, part number, description, manufacturer, application, range or span and expected setpoint or operating range.

4. Valve, damper, well and tap schedules showing sizes, configuration, characteristics, capacity, location, tag and part number.
 5. Control valve schedules shall be submitted in a spreadsheet format and shall include a separate line for each valve and a separate column for each valve attribute. The attributes shall include the valve tag number, the system served, the pipe size, close off pressure, body rating, target C_v , actual C_v , target pressure drop, actual pressure drop, fail safe position and actuator information.
- C. Equipment Layout Shop Drawings:
1. The Contractor shall submit shop drawings (floor plans) showing proposed layout and installation of all network and power equipment (panels and devices) and the relationship to other divisions. The drawings shall be drawn to a suitable scale. Show plan and elevation views and adequately indicate service space requirements, mounting, electrical connections, concrete work as required to completely coordinate the installation with other trades.
- D. Control System Drawings
1. System Architecture:
 - a. BAS riser diagram showing all DDC controllers, operator workstations, network controller, repeaters, bridges, switches, gateways and network wiring and how these devices will interface to the existing campus JCI System.
 - b. Indicate network number, device ID, address, device instance, MAC address, drawing reference number, and controller type for each control unit. Indicate media, protocol, baud rate, and type of each LAN. Indicate media, protocol, baud rate, and type of each LAN. All repeaters, end-of-line resistors, junctions, ground locations etc. shall be located on the diagram.
 2. Panels and controllers layout and point list including device tag number, point type, system name, object name, expanded id, display units, address, cable destination etc.
 3. Wiring diagrams, including wiring between panels and between panels and devices. Diagrams shall show, in addition to the automatic control system installation, the wiring required to interface with the self-contained equipment and motor control circuitry, all of which interfaces with and controlled by the BAS. Data shall be derived from and submitted with approved diagrams from the manufacturer. The required data shall be submitted as an integral part of the BAS submittal even if the required data is submitted under a separate cover by another discipline.
 4. Project specific manufacturer shop drawings where applicable (Custom control panels, sensor/transmitter pairs etc.)
 5. Schematic flow diagram of each air and water system (Process and Instrumentation Diagrams) showing fans, coils, dampers, valves, pumps, heat exchange equipment and control devices. All physical points on the schematic flow diagram shall be indicated with names, descriptors, and point addresses identified as listed in the point summary table.
 6. Software submittals shall contain narrative descriptions of sequence of operations and programming flow charts. The sequence of operations shall be fully developed and referenced to the devices used identified by tag numbers as shown on the P&I (Process

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- & Instrumentation diagrams). Show all calculations and set points. In a matrix format, show alarms, alarm thresholds and settings.
7. Any additional details required by the AE (Architect/Engineer) to demonstrate that the system shall function as intended.
- E. Graphics: Graphics proposed for all systems including but not limited to: Floor plans, AHU systems, chilled water and hot water systems, steam systems (when provided), room terminal unit systems and miscellaneous mechanical, electrical and plumbing systems. Also include floor plan graphics with room sensor locations with current values, locations of panels and examples of trending and custom reports.
- F. Sequence of Operations: See drawings.
- G. All drawings and diagrams shall be generated using the Visio Professional or AutoCAD release 2014 or higher and shall be a minimum size of 11 x 17. The Architect will furnish architectural floor plans backgrounds on floppy discs, Zip discs or CD-ROM or post on an FTP site.
- H. The Contractor shall clearly identify variations from the Contract Documents, if any, and document the reason for such variation.
- I. No material or equipment shall be installed before its product data has been submitted, reviewed and returned to the Contractor with the note "NO EXCEPTIONS TAKEN", or the note, "MAKE CORRECTIONS NOTED" marked thereon. In the event of the latter note, the correction noted shall be made and noted in the as-built set. Materials installed or work performed without the review of drawings and/or review of software flow diagrams is subject to rejection.
- J. Digital copies (unless more required by Division 1) of product data for materials and equipment covered by each Section of this Division shall be submitted for review.
1. Materials and equipment covered by an individual section shall be bound together and submitted as one package along with a summary spread sheet listing the various components submitted and their intended use and application.
 2. The Contractor shall submit the required data in a timely manner and shall allow reasonable time for review and processing. The Contractor shall assume full responsibility for delays incurred due to rejected items.
 3. Non-rejection of an item shall in no way obviate compliance with the Contract Documents.
 4. The Contractor must certify and sign each section of the submittal stating that he has reviewed all of the materials included in the submittal and the submittal is in compliance with the contract documents.

1.5 OPERATION MANUALS

- A. Provide complete operation and maintenance manuals, as required in Section 01700, for all systems. Manuals shall be contained in suitable loose-leaf binders with project identification on the cover and sections separated by individual tabs.
- B. The operation and maintenance manuals shall contain all information necessary for the operation, maintenance, replacement, installation, and parts procurement for the entire BAS

and all associated field devices. This documentation shall include specific part numbers, software versions, data and configuration files. A complete recommended spare parts inventory list shall be included with procurement lead time and expected frequency of use of each part clearly identified.

C. Workstation User's Manual shall contain the following information as a minimum:

1. System overview and networking concepts
2. Login and navigation through various menus
3. Establish and modify set points and schedules
4. Upload and download software, set points, schedules, operating parameters and status to and from the operator workstation and field hardware.
5. Collect trend data and generate trend plots
6. Enable and disable alarms and messages
7. Generate Report.
8. Backing up software and data files
9. Using the operator workstation with 'third party' software

D. Project Engineering Manual shall contain as a minimum:

1. System architecture overview
2. Hardware cut-sheets and descriptions of installed products and accessories, including Installation, mounting and connection details.
3. Wiring diagrams for all controllers and field hardware
4. Complete parts list and maintenance instructions for all installed products.
5. Commissioning, setup and backup procedures for all software and field controllers, workstation and devices.
6. Listing and description of basic terminology, alarms, messages and frequently used commands or shortcuts.

E. Software Documentation shall contain as a minimum:

1. Graphical representation of all control algorithms for every piece of mechanical equipment controlled on the project, together with a glossary or icon symbol library detailing the function of each graphical icon. 'Line by line' computer program documentation is unacceptable.
2. Detailed description of control sequences used to achieve the specified sequences.
3. Graphical representation of the mechanical equipment hierarchy for the project including all equipment controlled by the BAS. I.e. a VAV terminal box may be the source for

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increased cooling demand and requires the primary VAV AHU to operate which requires the chillers to operate.

4. Detailed listing of all specified alarm and event messages programmed for designated mechanical/electrical equipment and required operator action.
5. Documented listing of all system software, including the operating system and the system application programs. Listing shall include sufficient information to allow a person familiar with the programming language, but unfamiliar with the program, to understand it.
6. Graphic flow diagrams "Flow charts" of all software programs used on this project.

F. Manuals shall also contain the following information:

1. All information required by and specified in the "Submittals" section of these Specification in its final as-built form incorporating all revisions made as a result of the submittal process, during the installation, start-up or acceptance portion of the project.
2. CAD generated sketches of system graphics showing all monitored systems, data (measured and calculated), point addresses, and operator instructions.
3. As-built wiring diagrams of the complete system, all its components and devices.

G. In addition to the drawings included in the Operation Manuals, provide one digital set

H. For systems requiring a dedicated control panel (AHU's, CHW and HW systems, etc. the BAS contractor shall leave a printed copy of that particular systems flow diagram, SOO, wiring diagram and bill of material inside the controls enclosure.

1.6 INSTALLATION

- A. The installation shall include: Hardware installation, programming and supervision, checkout, adjusting and validating, necessary for a complete fully operational system.
- B. The BAS Subcontractor shall furnish and install all necessary conduits, control wiring, low voltage power wiring and conduit to control panels and field devices and all interlock wire and conduit as shown on the drawings, stated in the sequence of operation and listed on point list and necessary for the proper operation of all specified systems.
- C. Power supply, conduit and wiring from distribution panels to BAS field panels and devices, such as, but not limited to, valve actuators, terminal box controllers, damper actuators, , are a part of the work of this Section. Power supply shall be from emergency power source for all equipment connected to emergency power and/or used for Fire Life Safety operation.
- D. Control wiring and conduit to automation field panels and devices, such as, but not limited to, valve actuators, terminal box controllers, damper actuators, , are a part of the work of this Section.
- E. All wiring to outdoor panels and devices shall be arranged so that the conduits enter the panels and devices from the bottom in order to minimize the risk of water leaks. All conduit entries into outdoor panels and devices must be made with special weatherproof fittings.
- F. Disconnects as required by the UMC 2013 section 308.0 "Means of Disconnect", are a part of the work of this Section.

G. Wiring

1. All wiring performed by the BAS Subcontractor shall be installed in accordance with the requirements of Division 26 as well as all current and applicable local and national codes including but not limited to:
 - a. NEC (NFPA 70) – National Electrical Code
 - b. CMC – California Mechanical Code
 - c. CFC – California Fire Code
 - d. CBC – California Building Code
2. Except for Smoke Control systems, and unless required by Division 26 specifications, plenum-rated low voltage wiring may be installed without conduits in accessible, concealed spaces above ceiling plenums, if installed in a neat workmanlike manner, suspended from the structure on hangers and not touching any hot surfaces (coils). Laying bare wires and cables on the ceiling grid is prohibited.
3. For Smoke Control systems, and if required by Division 26 specifications, in addition to meeting the requirements of the electrical codes, all wiring, regardless of voltage, shall be fully enclosed within continuous raceways (conduit).
4. Concealed wiring within partition wall to temperature sensors needs to be in conduit to 8ft AFF.
5. All wiring must be color-coded and all terminations shall be numbered in accordance with applicable wiring standards and Division 26 requirements.

H. Dampers

1. All modulating and two position automatic control dampers, combination fire/smoke dampers and smoke dampers, whether shown on drawings or not, are included under work of Division 23. Any additional dampers not shown on the Drawings, but required to complete the work of Sections 25 55 00 through 25 55 60, shall be selected under the work of Section 25 55 30, but furnished and installed under Section 23 33 00.
2. Damper actuators for all modulating and two position dampers, furnished under Section 23 33 00, shall be furnished and installed under this Section. Provide all additional relays, control wiring and end switches for monitoring the status and controlling these dampers as required by the sequence of operation. Actuators for Smoke and Combination Fire/Smoke dampers shall be furnished with end switches integral with the dampers as a complete UL listed assembly under the work of Section 23 33 00.
3. Provide and install disconnects as required by the UMC 2001 section 309.0 "Means of Disconnect".

I. BAS contractor shall label all wiring and identify power supply circuit numbers and source panels as required.

J. Provide minimum 15 minutes UPS power modules for all control devices requiring uninterruptible power to meet the smoke control system requirements if Smoke Control is part

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of the scope of work or if equipment controlled by the BAS will operate on Standby or Emergency Power.

1.7 STARTUP AND COMMISSIONING SERVICES

- A. The BAS contractor shall participate in the Start-up procedures of all equipment and systems, such as the chilled water, hot water and steam systems, air handling systems, electrical, plumbing and Fire Life safety systems in the presence of the equipment manufacturer's representatives, Commissioning Authority or the Owner's representative as applicable.
- B. Upon completion of the installation and after a complete point-to-point check of the system, the BAS contractor shall load the system software and perform a safe system start-up following the procedures outlined in the various Division 23 sections. The BAS Contractor shall perform all necessary calibration, testing and debugging and perform all required operational checks to insure that the system is functioning in full accordance with these Specifications
- C. Each point in the system shall be tested for both hardware and software functionality. Provide a point to point test plan and test report to the commissioning agent.
- D. Each system under control of the BAS shall be tested against the approved sequence of operations per functional test procedures developed by the commissioning agent. The commissioning's agents report shall be submitted to the owner indicating that the installed system functions in accordance with the plans and specifications.
- E. The Contractor in the presence of the Owner's representative shall perform an acceptance test for all the system and train all the Owner's designated employees in accordance with the provisions herein and the Commissioning specifications issued by the Commissioning Authority.

1.8 DEMONSTRATION AND ACCEPTANCE TESTING (FUNCTIONAL PERFORMANCE TESTING)

- A. Refer to Commissioning specifications provided by Commissioning Authority

1.9 OPERATOR INSTRUCTIONS

- A. If installing JCI Metasys – the BMS contractor is to provide 24 hours of owner training.
- B. Alternate manufacture requirements: The system supplier shall conduct operator training on the system at acceptance time. Training shall be performed for three operator levels, and shall include the following, with a minimum of 16 hours for level 1, 24 hours for level 2 and 40 hours for level 3 of dedicated instructor time.
 - 1. Level 1: Two persons on basic data display and interpretation of graphics, addresses, and alarm and to interpret all alarm displays and printouts, to request all data displays.
 - 2. Level 2: Two persons (included in Level 1 class) on intermediate command and program change operations. This level of operators shall be trained to execute all manual commands (Start/Stop, Secure/Access), request all logs and change time based On/Off program times and load assignments.
 - 3. Level 3: One-person (included in Level 1 and Level 2 classes) on total system programming. This level of operators shall be trained to install all other programs and program changes specified herein to be keyboard programmable. This training shall

include complete understanding of all application packages, the custom written data file and user programs, and the ability to write and change new and existing specified programs. Trainer shall review and use documentation specified.

- C. During system commissioning and prior to the guarantee period, the BAS Contractor shall provide hands-on maintenance and operation training to the Owner's personnel. Training shall be performed for all the electrical and mechanical components of the BAS using a submitted and approved O & M manual prepared specifically for this project.
- D. The system supplier shall offer retraining of the Owner's personnel at the Owner's expense. Supplier shall furnish a syllabus of all training courses offered, and shall maintain a published schedule of training classes and a schedule of fees for classes.
- E. The training sessions shall be videotaped by the contractor and copy of the videotape handed to the Owner.

1.10 SYSTEM ACCEPTANCE

- A. Satisfactory completion is when the BAS contractor has performed successfully all the required testing by the Authorities Having Jurisdiction, the Commissioning Authority and by the specifications and demonstrated performance and compliance with all Contract Documents. System acceptance shall be contingent upon completion and review of the corrected deficiencies issued by all parties.
- B. Request a final review prior to system acceptance after completion of the following:
 - 1. Installation of all systems required by the Contract Documents.
 - 2. Satisfactory operation of all systems for a period of two weeks.
 - 3. Tagging and Identification of all equipment as required.
 - 4. Cleaning and painting if required.
 - 5. Submission and acceptance of submitted maintenance and service manuals.
 - 6. Submission of as built record drawings.
 - 7. Satisfactory completion of training programs.
 - 8. Delivery of maintenance tools and spare parts.

1.11 WARRANTY

- A. Refer to Division 01 Warranties
- B. The BAS contractor shall warrant the system (equipment, materials, programming and workmanship) for 12 months labor and 3 year parts after system commissioning acceptance and beneficial use by the owner. During the entire warranty period and at no additional cost to the owner, the BAS contractor shall maintain and update all software and firmware versions with the most current revisions issued by the system and/or product manufacturer. Also during the warranty period and at no extra cost to the owner, the BAS contractor shall provide all necessary adjustments and modifications required for a workable system consistent with the letter and intent of the Sequence of Operation of this specification

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- C. Within this period, upon notice by the Owner, any defects due to faulty materials, methods of installation or workmanship shall be promptly (no later than 48 hours after receipt of notice) repaired or replaced under the work of this section at no expense to the Owner.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Manufacturer: The Building Automation Control System shall be provided by the following:
 - 1. Johnson Controls, Inc. Metasys to match campus standard
- B. Installer: Johnson Controls, Inc. direct factory branch located in Folsom, CA.

2.2 MATERIALS & PRODUCTS

- A. Comply with individual Sections of this Division.
- B. As a minimum, the Building Automation System shall consist of the following:
 - 1. Network Control Units, Operator Workstations and File Servers
 - 2. Standalone General Purpose/Multiple Application DDC Controllers.
 - 3. Standalone General Purpose/Single Application DDC Controllers.
 - 4. Application specific controllers.
 - 5. Interfaces and gateways to third party controllers.
 - 6. Floor network controllers and expansion modules.
 - 7. Air and Hydronic Terminal equipment controllers
 - 8. Sensors, devices, valves and actuator, etc.
- C. 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.

2.3 USER INTERFACE

- A. Comply with the individual sections of this Division

PART 3 - EXECUTION

3.1 CONFERENCE

- A. Upon award of the Contract, before submittals are prepared and any work is started, arrange a meeting with the Commissioning agent, Engineer and Owner or their representatives to discuss the work in this Division.

3.2 BAS SYSTEM PROJECT MANAGER

- A. Have present at the project site, a project manager who shall, as a part of his duties, be responsible for the following activities:
1. Coordination and interface between this Subcontractor and all other trades, Owner, local authorities, and design team.
 2. Attendance at meetings as requested by the owner and the commissioning agent
 3. Supervision of field technicians and coordination of all activities between his subcontractors.
 4. Scheduling of work progress, manpower loading, material delivery, equipment installation and checkout.
 5. Coordination of all drawings and submittals between consultants, engineers other sub-trades and his subcontractors.
 6. Programming and commissioning of control system
 7. Engineering submittals

3.3 DRAWINGS

- A. The contract drawings are diagrammatic. Size and location of equipment is drawn to scale wherever possible. The contractor shall make use of all data included in all of the Contract Documents but must verify this information on site.

3.4 COORDINATION WITH OTHER TRADES

- A. The BAS Contractor shall provide all manpower and engineering services required to assist the HVAC Contractor and Balancing Contractor in testing, adjusting, and balancing all systems in the building. The BAS Contractor shall have a trained technician available on request during the balancing of the systems. The BAS Contractor shall coordinate all requirements to provide a complete air and water balance with the Balancing Contractor and shall include all labor and materials in his scope of work.
- B. Review the Contract Documents for the work performed by others in order to establish grade lines and eliminate interference.
1. Work, which interferes with the work of other trades, shall be removed and rerouted at the discretion of the Architect.
 2. No additional funds will be allowed for changes made necessary by interference with the work of other trades.
- C. When not shown on drawing, controls contractor shall generate floor drawing showing required locations for 120V power to transformers provided and installed by the controls contractor. Div 26 to provide 120V power as required
- D. Owner IT Network coordination: During system commissioning controls contractor to request IP address for new network level controllers. Patch cable to network engine is provided by others.

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3.5 COMMISSIONING

- A. In coordination with Division 22, 23 and 26 contractors and the Owner's representatives, provide services and manpower necessary for commissioning of the system as required by the Commissioning Specifications.

3.6 ACCESSIBILITY

- A. The installation of valves, dampers, thermometers, gauges, traps, clean-outs, control devices or other specialties requiring reading, adjustment, inspection, repairs, removal or replacement shall be conveniently and accessibly located with reference to the finished building. Refer to Division 15 sections.

3.7 PROTECTION

- A. Provide adequate protection for all finished work against physical damage from whatever cause during the progress of the work and until completion. During construction, properly cap all ducts, pipes and equipment to prevent the entrance of sand and dirt. Protect equipment against moisture, plaster, cement, paint or other hazards by covering with polyethylene sheets.
- B. All device locations shall be safe from water damage. No control devices shall be mounted under piping, valves or wall penetrations where water leakage may occur.

3.8 CLEANING

- A. After installation is complete, clean all systems as indicated below.
 - 1. During work in progress: Carefully clean the premises and keep all portions of the building free of debris.
 - 2. Chrome or nickel-plated work: Thoroughly polish.
 - 3. Factory finished items: Remove grease and oil and leave surfaces clean and polished.

3.9 WIRE LABELS/ DEVICE TAGGING

- A. Comply with the requirements of Division 23, Division 26 sections and the following:
 - 1. Controller Identification:
 - a. A nameplate securely fastened to the outside of the controller enclosure shall identify all controllers. Minimum size of letters shall be 1".
 - 2. Panel Identification:
 - a. A nameplate securely fastened to the outside of the controller enclosure shall identify all local control panels. Minimum size of letters shall be 1".
 - 3. Field Devices:
 - a. All field devices shall be identified by a typed (not handwritten) securely attached tag label. Each tag will consist of a stainless steel wire and stainless steel tag. The device name will match the object name on the control drawings. One tag will be provided for every valve, sensor, etc. Minimum size of letters shall be 1/2".

4. Panel Devices:

- a. A typed label shall identify all panel devices. Each tag shall consist of a black plastic tag with white lettering. Device names will match object on control drawings. One tag will be provided for every panel mounted device (transformers, controllers, etc.) Tags will be securely fixed to panel device with sticky back tape.

5. Wire Identification:

- a. All low and line voltage control wiring shall be identified as referenced to the associated control diagram, at each end of the conductor or cable. Identification shall be permanently secured to the conductor or cable and shall be typed.

END OF SECTION 255500

SECTION 255520

DIRECT DIGITAL CONTROL SYSTEM AND USER INTERFACE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, applicable portions of Division 1, Division 22, 23 and 26 – Basic Materials and Methods, apply to this Section.

1.2 DESCRIPTION

- A. General: Provide Direct Digital Control (DDC) system, complete, as shown, specified or required per Contract Documents.
- B. Work Included in this Section: Principal items of work include, but are not limited to, the following:
 - 1. General Purpose/Multiple Application DCC controllers.
 - 2. Single/Application Specific DDC Controllers.
 - 3. Single/Application Specific Controllers – Terminal Unit Controllers.
 - 4. System Software
 - 5. User Interface
- C. Related Work Not Included in This Section: Other Division 25 sections.

1.3 DESIGN INTENT

- A. The primary goals of the Building Automation System (BAS) are to maintain an environment automating and facilitating the technical operation of the facility, maximize the effectiveness of operations and maintenance personnel, and manage energy consumption, maintain IAQ and occupants comfort. As a result the BAS shall communicate with the JCI Metasys system on campus.

1.4 GENERAL REQUIREMENTS

- A. Requirements of Section 25 55 00 govern the work of this Section.
- B. Each system shall be provided with its own dedicated direct digital controller or application specific controller. Mechanical systems such as Air handling units, Air Terminal Units & Fan coil units or packaged systems shall not be controlled by more than one specific application controller. The intent of this section is to ensure stand-alone control for all major HVAC equipment that will require Proportional (P) Proportional & Integral (PI) or Proportional, Integral & Derivative (PID) control processes.

- C. Fans, dampers, sensors and devices included as part of a "system" (example: a relief fan associated with an air handler) shall be controlled and wired to the same controller and directly controlled by the same CPU.
- D. Provide 10% spare slots in all DCC panels for future expansion and addition of point modules.
- E. Furnish temperature control panels (TCP) of NEMA code gauge steel with locking doors for mounting all devices. 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. 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-built" control drawings shall be furnished in each control panel.

1.5 GENERAL SYSTEM REQUIREMENTS

- A. The Direct Digital Control (DDC) system shall be an integral part of Building Automation System (BAS). The system shall be modular in nature permitting expansion of both capacity and functionality through the addition of sensors, actuators, network controllers and operator devices.
- B. System architectural design shall eliminate 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
- C. 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. Systems, which do not meet this requirement, are not acceptable.
- D. Provide all of the required FDD system status' and faults of each HVAC package unit economizer within the BACnet Temperature Control System graphics. FDD controller must be manufactured by the DDC supplier and approved and listed on CEC website under Fault Detection Diagnostic System Declaration List (no exceptions). Third party FDD controllers are not acceptable.
- E. Where indicated by the University, provide Automatic Demand Shed Controls as required by the Building Energy Efficiency Standards - Title 24. Provide each HVAC system with Automated Demand Response (ADR) control and programming to change setpoints, reset setpoints, adjustable rate of change for setpoint change, ability to disable and allow manual control.
 - 1. System functionality shall be demonstrated and confirmed during system start-up regardless of presence of ADR signal generator. If ADR signal is not required per project documents signal shall be simulated in software to prove complete operation.
 - 2. Provide project names and a customer references of two projects that controls contractor has successfully implemented Automated Demand Response.

1.6 SYSTEM INTEGRATION

- A. Neutral Protocol: The neutral Protocol used between systems will be BACnet over Ethernet and shall comply with the ASHRAE BACnet standard. The BACnet system integrator shall allow bi-directional communications between the host system and BACnet system over an Ethernet network.
- B. BACnet integration into the Metasys network must respect existing BACnet devices and operational configurations. Failure to do so will cause outages ranging from individual devices to the entire downtown campus. BAS manufacturer must be able to utilize all of the range BACnet addresses so that any new building does not use any duplicate addresses. All costs impacts to state entity, including building tenant evacuation resulting from system outage, will be passed along to installing contractor.
- C. Direct Protocol
 - 1. The BAS shall include appropriate hardware equipment and software to allow bi-directional data communications between the BAS and third party manufactures' control panels. The BAS shall receive, react to and return information from multiple building systems including but not limited to chillers, boilers, variable frequency drives, power monitoring and metering systems, lighting systems and fire life safety systems. Integration shall be via RS-232 or RS-485 technologies.
 - 2. All data required by the application shall be mapped into the Network controller database and shall be transparent to the operator. Point inputs and outputs from the third party controllers shall have real time interoperability with the BAS software features
- D. Third party controllers shall communicate via BACnet MS/TP or IP. The manufacture of the equipment is responsible for providing and commissioning this gateway for use by the BAS system. The BMS contractor will only be responsible for integration gateways for 3rd party controllers with MODBUS.

1.7 SYSTEM ARCHITECTURE

- A. First Tier or Level 1 Network – BACnet IP
 - 1. The first tier or Level 1 network is the main backbone of the system and shall be based on an industry standard Ethernet TCP/IP.
 - 2. Network Control Units, Operator Workstations and File Servers shall reside on the first tier network without the need of gateway devices. PC Workstation shall connect to the campus network. Network engine controllers shall live on the tier 1 network. Air Handler controllers and central plant controllers shall reside on the first tier or Level 1 Ethernet network or the Level 2 MS/TP network..
 - 3. The first tier shall be connected to the facility wide network by way of standard network practices.
 - 4. The system architecture shall support 100% expansion capacity of all types of DDC panels, and all point types included in the initial installation.
- B. Second Tier or Level 2 Network; shall be BACnet MS/TP at 78,600 baud

- C. Dynamic Data Access: All operator devices, either network resident, shall have the ability to access all point status and application report data, or execute control functions for any and all other devices via the local area network. Access to data shall be based upon logical identification of building equipment.

1.8 NETWORK DESIGN GENERAL REQUIREMENTS

- A. Network design shall include the following provisions:
 - 1. Detection and accommodation of single or multiple failures of workstations, DDC panels or the network media. The network shall include provisions for automatically reconfiguring itself to allow all operational equipment to perform their designated functions as effectively as possible in the event of single or multiple failures.
 - 2. Message and alarm buffering to prevent information from being lost.
 - 3. Error detection, correction and re-transmission to guarantee data integrity.
 - 4. Default device definition to prevent loss of alarms or data, and ensure alarms are reported as quickly as possible in the event that an operator device does not respond.
 - 5. Synchronization of the real-time clocks in all DDC panels.

1.9 UNINTERRUPTIBLE POWER SUPPLY (UPS)

- A. Where indicated for supporting operator PCs, servers, and other equipment as indicated, provide a UPS as required

PART 2 - PRODUCTS

2.1 STANDALONE GENERAL PURPOSE/MULTIPLE APPLICATION DDC CONTROLLERS

- A. General: Standalone DDC panels shall be microprocessor based, multi-tasking, multi-user, and real-time digital control processors.
- B. 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 point list.
- C. Each General Purpose/Multiple Application Controller must be capable of standalone direct digital operation utilizing its own 10 bit processor, non-volatile flash memory, input/output, 12 bit A to D conversion, hardware clock/calendar and voltage transient and lightning protection devices. All non-volatile flash memory shall have a battery backup of at least five years. Firmware revisions to the module should be able to be made from the local workstation, portable operator terminals or from remote locations over LANs.
- D. The General Purpose/Multiple Application Controllers shall be expandable to the specified I/O point requirements. Each controller shall accommodate multiple I/O Expander Modules via a designated expansion I/O bus port. These expander modules shall expand the total point capacity of each controller. The controller, in conjunction with the expansion modules, shall act as one standalone controller.

- E. All communication and input/output signals shall be hardwired (wireless technology is not acceptable).
- F. Memory: Each DDC panel shall have sufficient memory to support its own operating system and databases including.
 - 1. Operator I/O.
 - 2. Control processes.
 - 3. Custom processes.
 - 4. Support applications.
 - 5. Alarm management.
 - 6. Dial-Up communications.
 - 7. Manual override monitoring.
 - 8. Energy management applications.
 - 9. Historical/trend data for all points maintenance.
- G. Each General Purpose/Multiple Application Controller shall execute application programs, calculations, and commands via a 10-bit microcomputer resident in the controller. All operating parameters for application programs residing in each controller shall be stored in read/writable nonvolatile flash memory within the controller and will be able to upload/download to/from the operator workstation.
- H. All point data; algorithms and application software within a controller shall be custom programmable from the operator workstation.
- I. Each General Purpose/Multiple Application Controller shall contain both software and firmware to perform full DDC PID control loops.
- J. Local Override Switches: Provide local override switches where shown on drawings. If required, the override switches will manually override automatic or centrally executed commands at the DDC panel via local manual switches. Provide operator override switches for binary output control points and gradual positioning switches for analog output control points as indicated in the point schedule. Local override switches are not required when the override function can be achieved at the output device (starter, valve, damper, etc.) and the device is located in sight of the DDC panel.
- K. Hardware Override Monitoring: Monitor the override status and position of each override as a discrete condition in addition to point status and alarm condition. 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.
- L. 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.

- M. Surge and Transient Protection: Provide isolation consistent with IEEE Standard 587-1980 at all networks terminations, and all field point terminations to suppress induced voltage transients.
- N. Power Fail Restart: In the event of loss of normal power, there shall be an orderly shutdown of all stand-alone DDC panels to prevent the loss of database or operating system software.
- O. Economizer Fault Detection and Diagnostics (FDD) as required by the CEC Building Energy Efficiency Standards - Title 24. Controller shall be approved and listed on the CEC website under Fault Detection Diagnostic System Declaration List.

2.2 STANDALONE GENERAL PURPOSE / SINGLE APPLICATION DDC CONTROLLERS

- A. The standalone DDC controller capacity shall be capable of being extended through the use of remote Single/Specific Application Controllers (SAC).
- B. Provide a minimum of one controller per air handler
- C. All communication and input/output signals shall be hardwired (wireless technology is not acceptable).
- D. Each SAC shall operate as a standalone controller capable of performing its specified control responsibilities independently of other controllers in the network. Each SAC shall be a microprocessor based, multi-tasking, real-time digital control processor.
- E. Each SAC shall have sufficient memory to support its own operating system and databases including:
 - 1. Control processes.
 - 2. Energy management applications.
 - 3. Operator I/O (portable service terminal).
- F. Each General Purpose/Single Application Controller shall execute application programs, calculations, and commands via a 10-bit microcomputer resident in the controller. All operating parameters for application programs residing in each controller shall be stored in read/writable nonvolatile flash memory within the controller and will be able to upload/download to/from the operator workstation.
- G. Each General Purpose/Single Application Controller must be capable of standalone direct digital operation utilizing its own 10-bit processor, non-volatile flash memory, input/output, 10 bit A to D conversion, hardware clock/calendar and voltage transient and lightning protection devices. All non-volatile flash memory shall have a battery backup of at least five years. Firmware revisions to the module should be able to be made from the local workstation, portable operator terminals or from remote locations over modems or LANs.
- H. All point data, algorithms and application software within a controller shall be custom programmable from the operator workstation.

- I. Each General Purpose / Single Application Controller shall contain both software and firmware to perform full DDC PID control loops.
- J. The operator shall be able to access any SAC point data or program through the network resident PC workstation or any PC or portable operator's terminal connected to any DDC panel in the network.
- K. 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.
- L. Power Fail 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.
- M. Air Handling Unit (AHU) Controllers: AHU controllers shall support, but not be limited to, the following configurations of systems to address current requirements as described in the Sequence of Operation portion of this specification, and for future expansion.
 - 1. Large Air Handling Units: Mixed Air - Single Path; Mixed Air - Dual Path; 100% Single Path; 100% Dual Path.
 - 2. AHU Controllers shall support all the necessary point inputs and outputs to perform the specified control sequences in a completely standalone fashion including but not limited to all associated dampers, sensors and actuators.
 - 3. AHU controllers shall have a library of control routines and program logic to perform the sequence of operation as specified in the Sequence of Operation portion of this specification.
 - 4. 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 one sample every 15 minutes shall be stored.
 - 5. Alarm Management: Each AHU controller shall perform its own limit and status monitoring and analysis to maximize network performance by reducing unnecessary communications.

2.3 APPLICATION SPECIFIC CONTROLLERS - TERMINAL UNIT CONTROLLERS

- A. Each terminal unit controller shall provide both standalone and networked direct digital control of pressure independent constant and variable volume terminal boxes. Each controller shall contain both software and hardware to perform full DDC P, PI and PID loop control and able to operate as a standalone controller and maintain the assigned space temperature in the event of a loss of communication with the network. Each controller shall execute application programs, calculations and commands via a 10-bit microprocessor resident within the controller. All communication and input/output signals shall be hardwired (wireless technology is not acceptable).

- B. The controller shall determine airflow by dynamic pressure measurement using a dead-ended differential pressure transducer. The transducer shall be maintenance-free and shall not require air filters. Each controller shall have the ability to automatically calibrate the flow sensor to eliminate pressure transducer offset error due to ambient temperature / humidity effects.
- C. When continuous operation at occupied flow is required, provide an "Autozero" module in order to provide periodic recalibration of the air velocity transducer without changing the air volume being delivered.
- D. The controller shall utilize a proportional plus integration (PI) algorithm for the space temperature control loops and shall continuously, adaptively tune the control algorithms to improve control and controller reliability through reduced actuator duty cycle. This feature will reduce commissioning costs, and eliminates the maintenance costs of manually re-tuning loops to compensate for seasonal or other load changes. The controller shall be able to support various types of zone temperature sensors with all options listed in the specifications.
- E. The controller shall provide the ability to download and upload configuration files, both locally and via the communications network. Controllers shall be able to be loaded individually or as a group using a zone schedule generated spreadsheet of controller parameters.
- F. All operating parameters for application programs residing in each controller shall be stored in the controller's non-volatile memory. Setpoint changes initiated over the network shall be written to the controller's non-volatile memory to prevent loss of setpoint changes and to provide consistent operation in the event of communication failure.
- G. Firmware or application programs, stored in the controller memory shall conform to the sequence of operation specified in Section 25 55 50. Controllers with manufacturer-preprogrammed sequences (configurable controllers) are unacceptable. Controllers shall be fully programmable and able to be reprogrammed in accordance with the specified sequences in section 25 50 50. Firmware shall be flash-upgradeable remotely via the communications bus to minimize costs of feature enhancements.
- H. The portable operator interface shall provide the user with the following functionality as a minimum:
 - 1. Display system status (heating, cooling, etc.)
 - 2. Display and change all point and set points
 - 3. Set and change heating/cooling dead bands
 - 4. Set and change PI loop gains
 - 5. Set and change system mode (occupied/unoccupied)
 - 6. Set and change system schedule
 - 7. Override all set points
 - 8. Override all digital and analog outputs
 - 9. Command all digital and analog outputs
 - 10. Select application mode

11. Assign controller address
- I. The controllers shall have LED indication for visual status of communication, power and all outputs
- J. Inputs
 1. Analog inputs shall monitor the following analog signals, without the addition of equipment outside the terminal controller cabinet:
 - a. 0-10 VDC Sensors
 - b. 10,000 Ω Type II Thermistors
 - c. 4-20 ma sensors
 - d. 0-5 VDC sensors
 2. Binary inputs shall monitor dry contact closures. Input shall provide filtering to eliminate false signals resulting from input "bouncing."
 3. For noise immunity, the inputs shall be internally isolated from power, communications, and output circuits.
- K. Outputs
 1. Analog outputs shall provide the following: 0-10 VDC (4-20 mA) outputs
 2. Binary outputs shall provide a SPST Triac output rated for 500mA at 24 VAC.
 3. For noise immunity, the outputs shall be internally isolated from power, communications, and other output circuits.
 4. Each controller shall provide modulating control 0-10 VDC (4-20 mA) to reheat valves. Floating Point Control is not acceptable.
- L. The controller's performance shall be self-documenting via on-board diagnostics. These diagnostics shall consist of control loop performance measurements executing at each control loop's sample interval, which may be used to continuously monitor and document system performance. The air-terminal controller, VAV, CAV and other types shall calculate exponentially weighted moving averages (EWMA) for each of the following. These metrics shall be available to the end user for efficient management of the air-terminals.
 1. Absolute temperature loop error
 2. Signed temperature loop error
 3. Absolute airflow loop error
 4. Signed airflow loop error
 5. Average damper actuator duty cycle.

- M. The controller shall detect system error conditions to assist in managing the zones. The error conditions shall consist of:
 - 1. Unreliable space temperature sensor
 - 2. Unreliable differential pressure sensor
 - 3. Starved box
 - 4. Insufficient cooling
 - 5. Insufficient heating
- N. Provide an electronic damper actuator with modulating control. Obtain damper torque ratings from the terminal box manufacturer and size the actuator accordingly. Actuator shall have a minimum of 35 in-lb. of torque and be protected against overload. Mount actuator on damper shaft without the need for additional linkage. A visual pointer shall indicate the position of the actuator. The damper actuator shall be capable of stroking 90 degrees in 95 seconds for damper positioning to speed commissioning and troubleshooting tasks.
- O. Terminal Unit Controllers shall carry the following listings: UL 916 and UL 864, UUKL classification (if part of a Smoke Control system) and FCC compliance.

2.4 SYSTEM SOFTWARE

- A. General
 - 1. The software programs specified in this section shall be provided as an integral part of the DDC panel and shall not be dependent upon any higher-level computer for execution.
 - 2. Software shall be modular in design to provide maximum flexibility, expansion and future revision of the system. All functionality described herein shall be regarded as a minimum.
 - 3. The system software shall include the following as a minimum:
 - a. Complete database entry.
 - b. Configuration of all controller and operator workstation application programs to provide the sequence of operation indicated.
 - c. Graphics of each system as shown in the I/O Summary Tables.
 - d. Report generation, configuration of reports and point summaries.
 - e. Event / alarms comprised of priority alarms, alarms, and messages.
 - 4. The system software shall be comprised of the following elements:
 - a. Graphical User Interface.
 - b. System Configuration Utilities.
 - c. Graphical Programming.

- d. Direct digital control software.
- e. Application software.

B. Control Software Description

1. Pre-Tested Control Algorithms: The DDC panels shall have the ability to perform the following pre-tested control algorithms.
 - a. Two-position control.
 - b. Proportional control.
 - c. Proportional plus integral control.
 - d. Proportional, integral, plus derivative control.
 - e. Automatic control loop tuning.
2. Equipment Cycling Protection: Control software shall include a provision for limiting the number of times each piece of equipment may be cycled within any one-hour period.
3. Heavy Equipment Delays: The system shall provide protection against excessive demand situations during normal start-up and also restart after power restoration periods by automatically introducing time delays between successive start commands to heavy electrical loads.
4. Energy Management Applications: DDC panels shall have the ability to perform any or all of the following energy management routines:
 - a. Time of day scheduling.
 - b. Calendar based scheduling.
 - c. Holiday scheduling.
 - d. Temporary schedule overrides.
 - e. Optimal start.
 - f. Optimal stop.
 - g. Night setback control.
 - h. Enthalpy switchover (Economizer).
 - i. Peak demand limiting.
 - j. Temperature compensated load rolling.
 - k. Fan speed/CFM control.
 - l. Heating/cooling interlock.

- m. Cold deck reset.
 - n. Hot deck reset.
 - o. Hot water reset.
 - p. Chilled water reset.
 - q. Condenser water reset.
 - r. Chiller, boiler and heat exchanger sequencing.
5. All programs shall be executed automatically without the need for operator intervention, and shall be flexible enough to allow user to customize. Programs shall be applied to building equipment as described in the Sequence of Operations.
6. Custom Process Programming Capability: DDC panels shall be able to execute custom, project specific processes defined by the user, to automatically perform calculations and special control routines.
7. Process Inputs and Variables: It shall be possible to use any of the following in a custom process.
- a. Any system measured point data or status.
 - b. Any calculated data.
 - c. Any results from other processes.
 - d. User defined constants.
 - e. Arithmetic functions (+, -, *, /, square root, exp, etc.).
 - f. Boolean logic operators (and, or, exclusive or, etc.).
 - g. On-delay/off-delay/one-shot timers.
8. Process Triggers: Custom processes may be triggered based on any combination of the following:
- a. Time interval.
 - b. Time of day.
 - c. Date.
 - d. Other processes.
 - e. Time programming.
 - f. Events (e.g., point alarms).

C. Dynamic Data Access

1. A single process shall be able to incorporate measured or calculated data from any and all other DDC panels on the local area network. All hardware and communications cabling necessary to enable any point in any process to be global shall be furnished, such that any existing or any spare point can be designated as a global point in software.
 2. In addition, a single process shall be able to issue commands to points in any and all other DDC panels on the local area network.
 3. Advisory/Message Generation: Processes shall be able to generate operator messages and advisories to operator I/O devices. A process shall be able to directly send a message to a specified device, buffer the information in a follow-up file, or cause the execution of a dial-up connection to a remote device such as a printer or pager.
 4. Custom Process Documentation: The custom control programming feature shall be self documenting. All interrelationships defined by this feature shall be documented via graphical flow charts and English language descriptors.
- D. Historical Data and Trend Analysis: A variety of historical data collection utilities shall be provided to automatically sample, store, and display system data in all of the following ways.
1. Continuous Point Histories: Standalone DDC panels shall store Point History files for all analog and binary inputs and outputs.
 - a. The point history routine shall continuously and automatically sample the value of all analog inputs at half-hour intervals. Samples for all points shall be stored for the past 24 hours to allow the user to immediately analyze equipment performance and all problem related events for the past day.
 - b. Point history files for binary input or output points and analog output points shall include a continuous record of the last ten status changes or commands for each point.
 2. Control Loop Performance Trends: Standalone DDC panels shall also provide high resolution sampling capability with an operator adjustable resolution of 10-300 seconds in one second increments for verification of control loop performance.
 3. Extended Sample Period Trends
 - a. Measured and calculated analog and binary data shall also be assigned to user definable trends for the purpose of collecting operator specified performance data over extended periods of time. Sample intervals of 1 minute to 2 hours, in one-minute intervals, shall be provided.
 - b. Each standalone DDC panel shall have a dedicated buffer for trend data, and shall be provided with sufficient memory to store a minimum of 5000 data samples.
- E. Data Storage and Archiving
1. Trend data shall be stored at the standalone DDC panels. Provide sufficient memory at the standalone DDC panels to store the trend data to be uploaded to hard disk storage when archival is desired.

2. Uploads shall occur based upon user defined interval, manual command, or when the trend buffers become full. All trend data shall be available in disk file form for use in 3rd Party personal computer applications.
- F. Runtime Totalization: Standalone DDC panels shall automatically accumulate and store runtime hours for binary input and output points as specified in the Point List portion of this Specification.
1. The totalization routine shall have a sampling resolution of one minute or less.
 2. The user shall have the ability to define a warning limit for runtime totalization. Unique, user specified messages shall be generated when the limit is reached.
 3. Analog/Pulse Totalization
 - a. Standalone DDC panels shall automatically sample, calculate and store consumption totals on a daily, weekly, or monthly basis for user selected analog and binary pulse input type points.
 - b. Totalization shall provide calculation and storage of accumulations of up to 99,999.9 units (e.g., kWh, gallons, kBtu, tons, etc.).
 - c. The totalization routine shall have a sampling resolution of one minute or less.
 - d. The user shall have the ability to define a warning limit. Unique, user specified messages shall be generated when the limit is reached.
- G. Event Totalization: Standalone DDC panels shall have the ability to count events such as the number of times a pump or fan system is cycled on and off. Event totalization shall be performed on a daily, weekly, or monthly basis.
1. The event totalization feature shall be able to store the records associated with a minimum of 9,999,999 events before reset.
 2. The user shall have the ability to define a warning limit. Unique, user specified messages shall be generated when the limit is reached.

2.5 USER INTERFACE

A. Mobile, Web Based, User Interface (MUI)

1. General
 - a. The Mobile, Web Based, User Interface shall be HTML5-compliant and provide device-agnostic access to the system from smartphones, tablets, portable and desktop computers. User Interfaces that require software installation on the client device (ex. Java, Microsoft Silverlight®, Adobe® Flash®), or software downloads from an online app store shall not be acceptable for these purposes.
 - b. The MUI shall provide system operators with a simple location-based navigation approach to finding information, including the ability to search for any location by name and to bookmark a location in a standard browser.

- c. The same user interface elements shall be accessible from any type of personal computer or mobile device running any type of operating system supported (ex. iOS, Android, Windows). It shall automatically adapt and optimize the display for the screen size and touch screen navigation.
- d. The user interface shall provide support for up to 50 concurrent users from individuals with defined access to the system.

2. Navigation Trees

- a. A dedicated location based navigation tree shall be provided as part of the UI in order to navigate to specific places within the facility on a hierarchical basis (typ. Facility, Building, Wing, Floor, Room)
- b. The location-based tree shall use place names familiar to the operator without training or familiarization regarding special codes and conventions utilized in the generation of the BMS.
- c. Clicking or tapping on a location name in the tree shall display the home page associated with the space and simultaneously expand the tree to display the next level of spaces below the one selected.

3. Dashboard Displays

- a. The user interface shall provide the ability to view equipment visualizations, floor plans, and/or other graphics on mobile or desktop client devices in a browser environment, without the need for additional plugins or software. Graphics shall be accessible via a space (for floorplans, campus maps, etc.) or equipment dashboard.
- b. Standard dashboards shall be configured for each defined space including one of the following predefined or custom elements:
 - c. Equipment Serving Space
 - d. Potential Problem Areas
 - e. Equipment Summary
 - f. Graphic Display (if specified)
 - g. Schedule
- h. Standard dashboards shall be configured for each system or device (typ. mechanical or electrical equipment) including the following predefined or custom elements:
 - i. Trend
 - j. Equipment Activity Summary
 - k. Equipment Relationships Summary
 - l. Equipment Data

- m. Graphic Display (if specified)
 - n. Schedule
 - o. Users with appropriate permissions shall have access to a Dashboards Manager that can change the display order of Summaries and Data elements, add or remove elements and apply custom dashboards layouts to equipment and space by type.
 - p. Dashboard Manager shall apply dashboards to spaces or equipment based on the viewing platform (Desktop/Tablet or Phone) in order to tailor the user experience to the needs of the specific user base.
 - q. Default dashboard displays by space and equipment type shall be created per the guidelines in this specification or by mutual agreement with the owner's representative.
4. Alarm Management
- a. The user interface shall provide a single display of all potential issues in a facility including items currently in alarm, warning, override, out-of-service and offline.
 - b. The user interface shall provide notification of new alarms, visually and audibly.
 - c. The user interface shall provide the ability to view a summary of alarms, including a chart of the number of alarms in each of the defined alarm priority ranges. The priority ranges should be filterable.
 - d. The user interface shall provide the capability to view multiple occurrences of the same alarm, ultimately providing the ability to acknowledge or discard all occurrences of the alarm in a single action.
 - e. The user interface shall provide the capability to view, and filter on, all alarms present in a well-defined mechanical system using the equipment serving equipment relationships.
 - f. The user interface shall provide the capability to acknowledge and discard all occurrences of at least 1000 alarms in one operation
 - g. The user interface shall provide the user with the understanding of what physical space is being affected when an alarm occurs. The user interface shall provide the ability to filter alarms by physical space affected when the alarm occurred.
 - h. The user interface shall provide the capability to monitor alarms 24/7 without requiring an active login to the system, accessible via segregated web page. The user interface shall provide the capability to enable or disable the 24/7 alarm monitor mode if desired.
5. Equipment Activity Summary
- a. The user interface shall provide a filterable, single display, of all activity related to a specific piece of equipment including user changes, discarded user changes, pending alarms, discarded alarms, and acknowledged alarms for at least one year of historical data.

- b. Filters shall allow only specific activities for specific data points occurring within a specific time and date window to be displayed.
 - c. It shall be possible to export a .csv copy of the currently displayed summary by clicking or tapping on the export icon.
 - d. Clicking on the information icon in front of any displayed activity listed in the summary shall expand the display to include the name of the user, server time, value prior to the activity, the ability to annotate the activity and a user selectable icon for displaying a trend graph of the point.
- 6. Equipment Relationships Summary
 - a. The user interface shall provide a summary of all equipment and spaces related to the operation of the system or device currently selected for viewing.
 - b. Include the capability to navigate to the home page of any related piece of equipment or space with a single click or tap on the desired element.
- 7. Equipment Data Summary
 - a. The user interface shall provide a summary of all data pertaining to a particular piece of mechanical or electrical equipment in a tabular format.
 - b. Clicking or tapping on any value in the summary shall display a related command panel allowing the user to command, override, or change service condition of the point selected and to annotate such actions for future reference
 - c. It shall be possible to export a .pdf copy of the report with a single click on the associated export icon.
- 8. Equipment Serving Space Summary
 - a. The user interface shall provide a summary of all mechanical and electrical equipment as defined in the points list that serves a selected space from the navigation tree.
 - b. The summary shall be capable of including a subset of the viewable points for each system representing the key elements of interest to operators without subjecting them to long lists of points irrelevant to basic operation.
- 9. Potential Problem Areas
 - a. The user interface shall provide a summary of all points in the system related to the space that are not operating correctly (e.g. alarm, off normal or not communicating correctly) in order to provide the operator with a quick update on current conditions.
 - b. The information shall include
 - 1) Point status (via color
 - 2) Point name
 - 3) Value of the point when the summary was taken

- 4) Equipment that contains the offending point
- 5) Space that is served by that equipment

10. Equipment Summary

- a. The UI shall provide a summary that allows the user to compare all similar equipment that serves the space as well as downstream (child) spaces in order to evaluate conditions quickly and determine patterns for troubleshooting purposes.
- b. Each unique equipment type shall be selectable and display a representative set of values along with the space(s) being served by the device. Equipment types can be selected from a dropdown menu in the summary.

11. User Defined Summaries

- a. Provide the capability to view, command, and modify large quantities of similar data in summaries without the use of a secondary application (e.g. a spreadsheet). These summaries shall be generated automatically or user defined. User defined summaries shall allow up to seven user defined columns describing attributes to be displayed including custom column labels with up to 100 rows per summary.

12. Trend

- a. The user interface shall provide the capability to view historical trend data from multiple pieces of equipment in both bar and line formats.
- b. The user shall have the ability to navigate to a selection list of frequently viewed trends.

13. Graphics

- a. The user interface shall display an equipment visualization or graphic within the context of its associated space (building, floor, room, etc.) or equipment dashboard.
- b. Graphics shall include the ability to define individual information layers for operator selection in order to clarify systems status and simplify operation on mobile devices. Where desired a master layer may be defined to include important information about the facility on all graphic screens.
- c. Graphics shall support the use of photo-realistic symbols as well as color change and animation to match the status of the related system control point.
- d. It shall be possible to export a time stamped .pdf file of the graphic being viewed in order to communicate the current conditions in the space or the equipment being viewed and to provide a historic record.
- e. An integral graphic manager shall be provided including the following features and capabilities:
 - 1) Creation and modification of graphics from any HTML5 capable browser without the need for additional plug-ins or software packages

- 2) Access to a full suite of pre-defined templates for air and water sourced HVAC applications as well as the ability to add custom templates as created for other use. Pre-aliased graphic templates may be defined and saved for repetitive representations of common mechanical and electrical equipment.
 - 3) A full suite of pre-defined three dimensional symbols for mechanical and electrical systems as well as all line, text and shape tools required for integration into a graphic with zoom and pan capabilities on multiple platforms and in multiple browsers.
 - 4) The ability to search and replace items in multiple graphics with a single command
 - 5) The ability to import and insert photos and images into the graphic
 - f. The ability of the graphics manager to create and edit graphics including the ability to bind graphic elements to the values and conditions of system points in both an on-line and off-line mode.
 - g. As required, the BMS Contractor shall provide software licenses in the name of the owner for programming, configuration and graphics building tools to allow designated representatives to make changes, modifications or additions to the system. While future updates or revisions may require an update fee, the owner shall incur no additional cost if they choose not to update. Systems that require any annual or time-limited licensing fees shall not be permitted.
14. Scheduling
- a. The user interface shall provide the capability to display, in a singular view, all of the effective schedules in the context of the space (building/floor/room, etc.) or equipment that the schedule affects. The software should have the ability to display an effective schedule, for the present, or a future date.
 - b. The user interface shall provide a report of all schedules affecting a space or equipment. The report shall provide the user details of events that comprise the weekly schedule and exception schedule(s). The report shall provide a means of viewing individual breakout scheduling elements for Weekly Schedule, Exceptions and Default Commands
 - c. The user interface shall provide the capability to efficiently change or modify schedules in mass quantities. This includes the capability to add, in bulk, exceptions to schedules, in addition to assigning, in bulk, weekly schedules.
15. Command and Control
- a. It shall be possible to command system analog and binary points via a dropdown menu accessed by clicking or tapping on the value shown in any equipment summary or graphic display and completing the task in the resultant menu including an optional annotation.
 - b. Commanding multiple points shall be possible on displays where multiple like system elements can be chosen.
16. Search

- a. Typing a text string in the Search box shall display a list of all occurrences of that string in the MUI. When a string is represented in the description of a space or network element, selecting it shall display its default dashboard.

17. Offline Operation

- a. The Mobile UI shall have the ability to operate in an offline mode in order to create or edit graphics and dashboard elements.

B. Site Management Portal and Associated Application Components

1. General – The Site Management Portal and its user interface shall serve as the primary tool for engineering personnel for the maintenance of the BMS
2. All features and functions of the Site Manager and associated user Interface defined in this document shall be available on any computer connected directly or via a wide area or virtual private network (WAN/VPN) to the automation network and conforming to the following specifications.
3. The software shall run be accessible and operational on a Microsoft Internet Explorer (11.0 or higher) browser and support the following functions:
 - a. Configuration
 - b. Commissioning
 - c. Data Archiving
 - d. Monitoring
 - e. Commanding
 - f. System Diagnostics
4. Operator Interface
 - a. An integrated browser based client application shall be provided as the user interface program for operators familiar with the detailed operation of the Building Management System and charged with the maintenance and optimization of the mechanical/electrical systems in the facility.
 - b. All Inputs, Outputs, Setpoints, and all other parameters as defined shown on the design drawings, or required as part of the system software, shall be displayed for operator viewing and modification from the operator interface software.
 - c. The user interface software shall provide help menus and instructions for each operation and/or application.
 - d. The system shall support customization of the UI configuration and a home page display for each operator.
 - e. All controller software operating parameters shall be displayed for the operator to view/modify from the user interface. These include: setpoints, alarm limits, time delays, PID tuning constants, run-times, point statistics, schedules, and so forth.

5. Navigation Trees

- a. The system will have the capability to display multiple navigation trees that will aid the operator in navigating throughout all systems and points connected. At minimum, provide a tree that identifies all systems on the networks.
- b. Provide the ability for the operator to add custom trees.

6. Alarms

- a. Alarms shall be routed directly from Network Automation Engines to PCs and servers. It shall be possible for specific alarms from specific points to be routed to specific PCs and servers. The alarm management portion of the user interface shall, at the minimum, provide the following functions:

7. Reports and Summaries

- a. Reports and Summaries shall be generated and directed to the user interface displays, with subsequent assignment to printers, or disk. As a minimum, the system shall provide the following reports:
 - 1) All points in the BMS
 - 2) All points in each BMS application
 - 3) All points in a specific controller
 - 4) All points in a user-defined group of points
 - 5) All points currently in alarm
 - 6) All points locked out
 - 7) All user defined and adjustable variables, schedules, interlocks and the like.
- b. Summaries and Reports shall be accessible via standard UI functions and not dependent upon custom programming or user defined HTML pages.

8. Schedules

- a. A graphical display for time-of-day scheduling and override scheduling of building operations shall be provided. At a minimum, the following functions shall be provided:
 - 1) Weekly schedules
 - 2) Exception Schedules
 - 3) Monthly calendars
- b. It shall be possible to define one or more exception schedules for each schedule including references to calendars

- c. Changes to schedules made from the User Interface shall directly modify the schedule database stored in an engine or server.

9. Security/Passwords

- a. Multiple-level passwords access protection shall be provided via roles and permissions. The feature will allow the system to base access on a user's job title or role and allow the user/manager access interface control, display, and database manipulation capabilities based on an assigned password.
- b. Each user shall have the following: a user account name a complex password or passphrase
- c. The system shall allow each user to change his or her password at will.
- d. Operators shall be able to perform only those commands available for their respective passwords. Display of menu selections shall be limited to only those items defined for the access level of the password used to log-on.
- e. Each login attempt is recorded in the system Audit Log with the option to record the IP address of the PC that made the login.

10. Historical trending and data collection

- a. Each Automation Engine shall store trend and point history data for all analog and digital inputs and outputs, as follows:
 - 1) Any point, physical or calculated, may be designated for trending. Two methods of collection shall be allowed:
 - 2) Defined time interval
 - 3) Upon a change of value
 - 4) Each Automation Engine shall have the capability to store multiple samples for each physical point and software variable based upon available memory, including an individual sample time/date stamp. Points may be assigned to multiple history trends with different collection parameters.
- b. Trend and change of value data shall be stored within the engine and uploaded to a dedicated trend database or exported in a selectable data format via a provided data export utility. Uploads to a dedicated database shall occur based upon one of the following: user-defined interval, manual command, or when the trend buffers are full. Exports shall be as requested by the user or on a time-scheduled basis.

11. Trend data viewing and analysis

- a. Provide a trend viewing utility that shall have access to all database points.

C. Mobile Access Portal Gateway

- 1. General: The Mobile Access Portal (MAP) Gateway shall provide a complementary extension to the DDC system user interface requirements previously described in these specifications. The MAP Gateway shall provide an HTML5 browser interface between

mobile devices and DDC controllers without the requirement for operational engines or servers. A task specific mobile application shall not be required to use the MAP Gateway.

- a. The MAP Gateway shall be a hardware/software device which consists of a combination WiFi Access Point hotspot and user interface web server, with BACnet MS/TP RS-485 connectivity, and optional Ethernet IP connectivity.
- b. When not connected via the Ethernet IP port, the MAP Gateway shall provide a secure, isolated connection to controllers on the BACnet MS/TP field bus with no opportunities to "jump off", or bridge over, to the site's IT infrastructure.
- c. The MAP Gateway shall not require the user to purchase or install any software or applications on the user's smart phone, tablet, PC, or smart device.
- d. The MAP Gateway shall include the following pre-configured user interface web pages linked to real-time data in the field controllers:
 - 1) Device List Page
 - 2) Device Home Page
 - 3) Device Alarm Page
 - 4) Point View/ Edit Page
- e. Airflow Balancing: The gateway shall provide a tool for VAV box commissioning and air balancing for controllers provided under this specification. Connectivity to the individual boxes will not require connection to each controller but rather a connection to a single device on the MS/TP network within WiFi range.
- f. The MAP Gateway shall include an RS-485 Port configured as BACnet MS/TP Master.

PART 3 - EXECUTION

3.1 INSPECTION OF CONDITIONS

- A. Examine all related work and surfaces before starting work of this Section. Report to the Architect, in writing, conditions, which will prevent proper provision of this work. Beginning of work of this Section without reporting unsuitable conditions to the Architect constitutes acceptance of conditions. Perform any required removal, repair or replacement of this work caused by unsuitable conditions at no additional cost to the Owner.

3.2 INSTALLATION OF CONTROL PANELS

- A. All DDC panels shall be installed in a neat workmanlike manner, in a convenient accessible location. Do not install any panel to be in a location where it may be subject to accidental damage or malfunction due to elements or vibrations from equipment, piping or ductwork.
- B. All panels shall be located indoors. No outdoors DDC panels on this project.
- C. Installation of Digital Terminal Unit Controllers

1. Terminal Controller, airflow transducer, damper actuator shall be shipped to the Terminal Box manufacturer for factory mounting. Factory mounting shall be the responsibility of the box manufacturer. Terminal box manufacturer to provide control transformer and all necessary fuses and disconnects required.
2. Terminal Box manufacturer shall factory install and wire the Terminal Controller, airflow transducer, damper actuator in a NEMA 1 UL listed enclosure. The terminal boxes shall arrive on site, pre-wired using screw connections and terminal blocks, so that connection of room temperature sensor, communications trunk, reheat valve and power shall complete the installation.
3. When terminal box is being fed from multiple power sources:
 - a. Separate each power source in accordance with NEC (Emergency power and Normal power)
 - b. Separate each power type in accordance with NEC (Low and High voltage)
 - c. Use a separate, local disconnect for each power source (Provided by terminal box manufacturer).
 - d. Clearly identify the different power sources and post a warning indicating that the terminal box is fed from multiple power sources.
4. All cost associated with shipping the Terminal Unit Controllers, actuators and transducers, furnished under this section, to the terminal unit manufacturer shall be borne by the BAS contractor.
5. Installation of Terminal Unit Controllers, actuators and transducers by terminal unit manufacturer will be at terminal unit manufacturer's cost.

3.3 INTEGRATION OF SYSTEM

- A. The Building Automation System Contractor must provide a list of all the mechanical equipment and other Building Automation Systems that their system is capable of seamlessly interfacing with as part of their proposal along with a list of projects as reference to validate their claim.
- B. At a minimum, the Building Automation System must be able to communicate through data lines, with the chillers, boilers, VFDs, lighting, fire alarm system and water treatment system for monitoring and control. Refer to other specification sections and/or Notice to Bidders for specific manufacturers on this project.
- C. Complete all inter-wiring between panels, operator terminals, field devices such as sensors, operators, etc. as required, in a workmanlike manner.

END OF SECTION 255520

SECTION 255530

ELECTRONIC SENSORS, DEVICES AND FIELD HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Controllers, electronic sensors, devices, instrumentation and field hardware, complete, as shown on the plans, specified in the point list, and required by the sequence of operations for a complete and functional control system.
 - a. Temperature sensors & transmitters
 - b. Relative humidity sensors and transmitters:
 - c. Air quality measurement
 - d. Water flow measurements
 - e. Hydraulic pressure and differential pressure transmitters
 - f. Water flow and level sensors and switches
 - g. Air pressure sensors and switches
 - h. Airflow measuring stations
 - i. Electrical power switches and sensors
 - j. Control devices
 - k. Automatic control valves
 - l. Damper actuators
 - m. Enclosures
 - n. Pressure monitoring systems (TSI)

B. Related Work:

1. Drawings and general provisions of the Contract, including General and Supplementary Conditions, applicable portions of Division 1, Section 23 05 00 – General Provisions and applicable Division 22, 23 and Division 26 sections.

C. Conditions:

1. Requirements of Section 25 55 00 govern the work of this Section.

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1.2 SUBMITTALS

- A. Comply with the requirements of Division 1 and Section 25 55 00.

1.3 QUALITY ASSURANCE

- A. General: Materials, equipment and installation shall comply with all applicable building laws and published standards as described in Section 17000. In addition, comply with the following standards:
 - 1. UL
 - 2. NEC
 - 3. ANSI
 - 4. OSHA
 - 5. ASHRAE
 - 6. SMACNA

PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide field devices for input and output of digital (binary) and analog signals into DDC hardware. Provide signal conditioning for all field devices as recommended by field device manufacturers, and as required for proper operation in the system.
- B. It is the Contractor's responsibility to assure that all field devices are compatible with controller hardware and software.
- C. Unless otherwise mentioned in this section, field devices specified herein are generally 'two-wire' type transmitters, with power for the device to be supplied from the respective controller. If the controller provided is not equipped to provide this power, or is not designed to work with 'two-wire' type transmitters, or if field device is to serve as input to more than one controller, or where the length of wire to the controller will unacceptably affect the accuracy, the Contractor shall provide 'four-wire' type equal transmitter and necessary regulated DC power supply as required.
- D. For field devices specified hereinafter that require signal conditioners, signal boosters, signal repeaters, or other devices for proper interface to controllers, Contractor shall furnish and install proper device. Such devices shall have accuracy equal to, or better than, the accuracy listed for respective field devices.
- E. Accuracy: As used in this Section, accuracy shall include combined effects of nonlinearity, non-repeatability and hysteresis. Sensor accuracies specified below shall be minimum accuracy requirements.

- F. Mount all sensors and transmitters in a convenient location, visible and accessible for maintenance. For duct mount sensors, a neoprene grommet (sealtite fitting and mounting plate) shall be used on the sensor to prevent air leaks.

2.2 TEMPERATURE SENSORS & TRANSMITTERS

A. Duct Temperature Sensors:

- 1. Provide 10,000 Ω Type II Thermistors sensing element. The system error (sensor and transmitter) shall not exceed $\pm 0.5^{\circ}\text{F}$ over the specified range.

B. Flexible Averaging Sensors:

- 1. Provide up to 25' continuous resistance element averaging sensor when sensing temperature in mixed air applications or where stratified conditions occur or when large quantities of air are being measured.
- 2. Also provide flexible averaging sensors when measuring temperatures downstream of a heating or cooling coil.
- 3. Position the sensor as close to the coil as possible to avoid any "hunting" of the valve and not too close in order to avoid any radiation. Install sensor in a crisscross pattern across the duct and provide temperature averaging over the entire length of the probe.

C. Rigid Averaging Sensors:

- 1. Provide sensors of the rigid averaging type downstream of air handlers and when duct size exceeds 12" in width. Probe length shall be equal or close to the duct width.

D. Single Point Sensors:

- 1. Single point sensors shall be allowed in branch duct. Single point sensors can also be used to measure return air temperatures.

E. General Space Temperature Sensors

1. Definition

- a. General space temperature sensors/transmitters are defined as sensors connected to and used by air-terminal box controller to control a room temperature.

2. Requirements

- a. Provide a 10K or 100K Ω thermistor type-sensing element with accuracy equal to or better than $\pm 0.36^{\circ}\text{F}$ at 77°F . Sensor to be factory calibrated and matched with specified controller.
- b. Space (room) temperature sensors shall be occupant warm cool adjustable, with override button and no display unless otherwise indicated. Space temperature, humidity and CO2 sensor shall be readable and setpoints adjustable by the BAS

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system operator through devices connected to the DDC system panels and operator workstations

c. Provide the following additional features where indicated:

- 1) For LCD zone temperature sensors provide at a minimum four (4) color indicators (blue, red, amber and green) that will cast a glow onto the wall below the sensor to be used as visual indicator to the occupants of the condition of the system. The color and on/off state of the Status Light indicator shall be fully programmable.
 - a) Red LED shall be used to locally identify Economizer Fault Detection and Diagnostics (FDD) fault as required by Building Energy Efficiency Standards - Title 24.
- 2) Digital room temperature and set point display where required.

F. Specific Application Space Temperature Sensors

1. For special applications, procedure rooms and sensitive spaces and/or where humidity control is required, provide a space temperature sensor consisting of a 100 Ω Platinum RTD with a TCR of 0.000385 $\Omega/\Omega/^{\circ}\text{C}$. The temperature sensor and transmitter shall be matched and factory calibrated to eliminate sensor tolerance from system accuracy. The system error (sensor and transmitter) shall not exceed $\pm 0.5^{\circ}\text{F}$ over the specified range.

G. Fluid Temperature Sensors - Immersion Probes

1. Provide, 10,000 OHM Type II Thermistor sensing element with temperature coefficient of 0.000385 $\Omega/\Omega/^{\circ}\text{C}$. The system error (sensor and transmitter) shall not exceed $\pm 1^{\circ}\text{F}$ over the specified range.
2. Provide sensing element in temperature conductive compound in sealed moisture/waterproof stainless steel tube with a threaded fitting. Install in an appropriate matching stainless steel thermowell pressure rated and constructed in accordance with the system working pressure.
3. Fill the thermowell with a thermal-conducting compound. The sensor and the well shall be supplied as a complete assembly including wellhead Greenfield fitting. Mount the thermowell in an elbow of the pipe facing the direction of flow.
4. Sensors used in BTU or process calculations shall be matched and accurate to $\pm 0.1^{\circ}\text{F}$ over the process temperature range. Submit a manufacturer's calibration report indicating the calibration certification traceable to the National Bureau of Standards (NBS).

2.3 RELATIVE HUMIDITY SENSORS AND TRANSMITTERS:

A. Fast response relative humidity transmitters with the following features

1. Range: 0-100% RH and accuracy better than $\pm 3\%$ and $\pm 1.7\%$.
2. Operating range of 23 $^{\circ}\text{F}$ to 131 $^{\circ}\text{F}$.

3. Output signal 4 to 20 mA or 0-10V with screw terminals for wire connections.
4. Two point field calibration of transmitter.
5. Filter for sensor protection.

B. General

1. When sensing mediums below the ambient dew point, provide a suitable case insulator to prevent internal condensation and moisture on the sensor and transmitter.
2. Provide an NIST traceable calibration certificate with each sensor/transmitter where required.

C. Acceptable Manufacturers

1. Vaisala Veris Dwyer ACI JCI

2.4 OUTSIDE AIR SENSORS (IF REQUIRED)

A. General:

1. Sensors shall be mounted on the roof in an appropriate housing designed to withstand the environmental conditions to which they will be exposed.
2. The sensors shall be located so they shall not be affected by exhaust air, solar effect (except for solar compensator) or cooling tower air circulation. The sensors shall be located where they can be serviced without the need of a ladder or lift equipment.
3. For Outside Air Temperature, provide a Dwyer TE-RND-B outside air temperature sensor with sun shield.
4. For Outside Air Temperature and Humidity, provide a Dwyer RHP-3R3B combo outside air temperature sensor and humidity sensor with sun shield.

2.5 AIR QUALITY MEASUREMENTS

A. Duct Mounted CO₂ Sensors and Transmitters:

1. Provide a self-compensating, return air duct mounted CO₂ transmitter with an industry standard, 4-20 ma output signal. Measurement range shall be 0 to 2000 ppm with an Accuracy (including repeatability, non-linearity and calibration uncertainty) $\pm$ (2 % of range + 2% of reading). Long-term stability $<\pm 5$ % of range /5 years and a Response time (63%) of 1 minute.
2. Locate the sensors to be as shown on the drawings.
3. Transmitter shall be by Vaisala , Veris, Dwyer, Setra or ACI, JCI

B. Wall mounted CO₂ Sensors and Transmitters

1. CO₂ sensor shall have an accuracy of +/- 30 ppm over the range of 0–2000 ppm or better.

2. CO2 sensor shall utilize Automatic Baseline Correction to maintain sensor calibration without the need for manual calibration.

C. CO Sensors and Transmitters

1. Sensor shall utilize state of the art enhanced MOS sensor technology microprocessor controlled and compensated for temperature and humidity. Unit shall not require field calibration. The sensor shall output a 4 –20mA and can be mounted up to 5,000 ft from the BAS panel. Additional RS 485 interface shall be provided for optional direct connection to a BAS.
2. The monitor unit shall have discrete LEDs to indicate Warning, Alarm and Sensor status. Auxiliary relays shall also be provided for remote indication
3. Transmitter shall be by MSA model TGM or equal

D. Refrigerant Monitoring:

1. The Refrigerant Monitor shall The Chillgard RT Monitor utilizes stable and selective photoacoustic infrared (IR) technology to sense refrigerant gases at levels as low as 1 part-per million and can be configured to monitor from up to eight remote areas. The Refrigerant Monitor shall be capable of being configured to detect a specific refrigerant or a group of refrigerants.
2. The analyzer shall be capable of monitoring over a range of 0-1000 ppm with a sensitivity of 1 ppm in the 0-100 ppm range and +10% of reading in the 100-1000 ppm range.
3. Three separate alarm set point levels shall be provided. The set points shall be independently adjustable for any value for a given range. The set points shall provide drive signals to user interface relays. The alarm set points shall have the capability of providing the user a selection of latching or non-latching.
4. The system shall be capable of supplying a 4-20 mA isolated sourcing signal and 0-10 VDC, signal representing the gas concentration being sampled.
5. Refrigerant Monitor shall be Chillguard RT by MSA or equal.

2.6 WATER FLOW MEASUREMENTS

A. General

1. Install flow sensor as shown on the P&ID and locate in pipe runs in accordance with manufacturer instructions and specifications for length of straight pipe runs required before and after the device to ensure accuracy.
2. Provide an integral Stainless Steel Three-Valve manifold for isolation of transmitter without depressurizing the lines.
3. Sensor and transmitter (specified hereunder) shall be sent to a certified laboratory for an NIST traceable calibration in order to achieve better than +/- 0.5% measurement accuracy. Provide and submit all flow calibration reports.

B. Magnetic Flow Meter – Chilled, Domestic and Hot water

1. Provide a magnetic flow meter with an accuracy up to $\pm 0.15\%$ of volumetric flow rate accuracy over 13:1 flow turndowns, $\pm 0.25\%$ over 40:1 flow turndown.
2. The magnetic Flow Meter shall be Rosemont, Onicon or equal.
3. If meter is installed higher than 4' AFF, a remote display must be provided.

C. Differential Pressure Flow Meter:

1. Where straight pipe required for Magnetic Flow Meter cannot be provided, provide a differential pressure type flow meter. Construction material shall be 316 Stainless steel with flanged end fittings.

2.7 STEAM MEASUREMENTS

A. Vortex Shedding Meter

1. Provide Rosemont or equal Vortex Shedding flow meter with integral temperature sensor and reducer (if needed). Sensor accuracy shall be 1.35% of rate.
2. Wetted material shall be 316 SS. Transmitter shall be remote mounted or integral mounted (depending on accessibility) on flow tube with integral configuration/display module. Transmitter shall be capable of 4-20mA and HART Protocol.
3. Mount the meter horizontally. Avoid mounting transducers downstream of modulating valves or butterfly valves. Upstream Straight Run should be 20 Diameters upstream, and 10 diameters downstream. Straight runs can be reduced with filed adjustments.
4. Model number: 8800D-R-060-S-A3-N-1-D-1-MTA-M5-RXX-Q4. Consult factory to confirm sizing for specific flow conditions.

2.8 HYDRAULIC PRESSURE AND DIFFERENTIAL PRESSURE TRANSMITTERS:

- A. Provide standard 4-20mA output. Incorporate a temperature measurement to compensate for thermal effects and provide transient protection. Accuracy shall be $\pm 0.075\%$ of span or better.
- B. Provide transmitter with a LCD display and failure mode alarm capabilities.
- C. Wetted parts of the sensor and electronic housing shall be 316L stainless steel.
- D. Differential Pressure Transmitter shall be Rosemount model 3051CD with LCD display and integral mount 3-valve manifold. Pressure Transmitters shall be Rosemount, Veris, Setra, ACI or equal.

2.9 WATER FLOW AND LEVEL SENSORS AND SWITCHES

A. Water Flow Switches:

1. Provide differential pressure type flow switch with adjustable sensitivity and setpoint. When a differential pressure is exerted upon the sensing elements a single pole,

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double throw (form "C" contact) will be operated. Switch shall be PENN model P74 for 150 psig system and "Merco" DP series for 300 psig systems or equal.

B. Liquid Level Switches:

1. Provide 2-position level switches where required or shown. Floating mercury switch type, completely sealed against moisture and corrosion. Mount where accessible for maintenance and inspection. Switch contact "make" and "break" set point shall be adjustable. Switch shall be Weil 8230 Series or equal.

C. Liquid Level Sensors and Transmitters

1. Kele or equal. Type depends on application.

2.10 AIR PRESSURE SENSORS AND SWITCHES

A. Differential Pressure Switches

1. Pressure switches shall have a repetitive accuracy of $\pm 1\%$ of their operating range and shall withstand up to 150% of rated pressure. Sensors shall be diaphragm or Bourbon tube. Actuation shall be adjustable over the operating pressure range.
2. The switch output shall be a SPDT snap switch rated for the application. Provide the switch complete with mounting brackets sensing tips and electrical screw type connections.
3. High and low differential pressure cut off switches shall be of the manual reset type for equipment or personnel protection. Switch to be UL Listed.

B. Differential Pressure Transmitter

1. Sensor shall have no moving parts and shall include NIST standards certification. Provide a standard 4-20mA analog output signal with an accuracy of $\pm 0.25\%$ of full span. Connections shall be barbed fittings for tubing and screw type for electrical connections.
2. Differential pressure transmitters for duct static pressure shall have a range of 0"-2.5" w.g. For differential pressure across pre-filters the transmitter shall have a range of 0"-1" for final filters, a range of 0"-2.5" w.g. maximum or as scheduled on the drawings.
3. Manufacturer and Model Number: Setra with LCD Display or equal.

C. Shielded Room, Plenum and Space Static Pressure Probes (SAP)

1. Provide for each room or space, a shielded static pressure probe suitable for surface mount (SAP/1), recessed flush (SAP/3) or suspended (SAP/2) mounting, complete with multiple sensing ports, pressure impulse suppression chamber, airflow shielding, and 1/8" FPT (3/4" FPT (for S.A.P./2)) takeoff fitting, all contained in an aluminum (316 stainless steel) casing, with brushed finish on exposed surfaces.
2. The probes shall be capable of sensing the static pressure in the proximity of the sensor to within 1% of the actual pressure value while being subjected to a maximum airflow of 1000 FPM from a radial source.

3. The shielded room or space static pressure sensors shall be the SAP/1/2/3 shielded static air probes as manufactured by Air Monitor Corporation or equal.
4. The shielded plenum static pressure sensors shall be the SAP/3 shielded static air probes as manufactured by Air Monitor Corporation or equal.
5. For room sensing the range shall be bidirectional $\pm .1$ or $.25$ " w.g. (Setra 2641-0R1WB or Dwyer 607-0B) or equal.

D. Static Outside Air Probe (SOAP)

1. Provide for the room or space static pressure indicating or controlling systems an outdoor static pressure sensor constructed of 10 gage Type 316 stainless steel with a 2" diameter FPT connection.
2. The outdoor air probe shall be capable of sensing the outside atmospheric air pressure to within 2% of the actual value when subjected to radial wind velocities up to 40 miles per hour with approach angles up to 30° to the horizontal.
3. The static outside air probe shall be the SOAP as manufactured by Air Monitor Corporation or equal.

E. General Requirements for Pressure Switches and Transmitters

1. Select sensor with appropriate range for the application so that normal operation will occur at mid range of the sensor span.
2. Duct sensing pressure applications where the velocity exceeds 1500 fpm shall utilize a static pressure traverse probe.
3. Mount Pressure Switches and Transmitters outside of the Air Handler Enclosure. High and Low static pressure switches shall be installed in a lockable and labeled enclosure.

2.11 AIRFLOW MEASURING STATIONS

A. General

1. Application: For pressurization control using the fan tracking method, for air flow measurements and minimum outside air measurement and control.
2. The Air Flow Measuring Station shall consist of an airflow measuring sensor(s) and matched transmitter.
3. Fan Air Flow Measuring Stations shall be out of the air stream type (piezo ring) provided and installed by the Air Handler manufacturer. The Transmitters shall be calibrated and programmed by the Air Handler manufacturer.
4. The manufacturer shall produce and submit a report containing all formulas, values and calibration data for verification and record.
5. For duct mounted and for OA measurements when air velocities less than 400 fpm are anticipated, a thermal dispersion type flow meter shall be provided.

B. Air Flow Traverse Probe Stations

1. Airflow traverse probes shall be of the insertion type, capable of continuously measuring air volume in the duct served.
2. Each airflow traverse probe mounted within the station shall contain multiple total and static pressure sensors located along its exterior surface, and internally connected to their respective averaging manifolds.
3. The flow sensors shall not protrude beyond the surface of the probe(s), and shall be the offset (Fechheimer) type for static pressure and the chamfered impact type for total pressure measurement. The airflow station's measured accuracy shall not be affected by directional flow having yaw and/or pitch angles up to 30°.
4. Stations shall be AMCA certified and be capable of measuring the airflow rates within an accuracy of $\pm 2\%$ without the use of correction factors over a velocity range of 400 to 4000 FPM. (For velocities less than 400 fpm use the Thermal Dispersion type)
5. Airflow measuring station shall be Air Monitor "VOLU-probe/VS" or FAN-E for locations with limited straight duct runs.
6. Installation: For duct mounting follow the manufacturer installation instructions for location and quantity of required sensors. For outdoor installations provide the transmitter in a NEMA 4 enclosure
7. The transmitter shall be: Air Monitor Corporation or Ebtron or JCI. The transmitter shall have and accuracy of 0.25% of natural span including non-linearity, hysteresis and repeatability. The transmitter shall be provided with an automatic zeroing circuit.

C. Thermal Dispersion Type

1. Sensors: Sensors shall use thermal dispersion technology with two "bead in glass," hermetically sealed thermistor probes at each measurement point. The system shall be factory calibrated to NIST traceable standards and not require calibration or adjustment over the life of the equipment. Each sensor probe shall be provided with a UL plenum rated cable with terminal connectors and gold plated contacts.
2. Transmitter: The transmitter shall be microprocessor based and capable of processing up to 16 independent sensing points per location. The transmitter shall have 16-character alphanumeric display for airflow and diagnostics. The output shall be 0-10VDC or 4-20 mA selectable. The transmitter shall be capable of indicating individual sensor airflow and ignore any malfunctioning sensors.
3. Installation: For duct mounting follow the manufacturer installation instructions for location and quantity of required sensors. For outdoor installations provide the transmitter in a NEMA 4 enclosure.
4. Airflow measuring station and transmitter shall be Ebtron Gold series model GTA116-PC or JCI equal.

2.12 ELECTRICAL POWER SWITCHES AND SENSORS

A. Current Switches

1. For 1/5 to 30 HP motors, provide self powered precision solid-state switches; UL listed with direct input to the BAS for general status and proof-of-performance monitoring. Provide switch with adjustable set point, "Trip" and "Power" LED indicators. Provide screw type terminations. Switch to by Veris Industries model H-608 (Split Core).
2. For 35 HP and above, provide self powered precision solid-state switches; UL listed with direct input to the BAS for general status and proof-of-performance monitoring. Provide switch with adjustable set point, "Trip" and "Power" LED indicators. Provide screw type terminations. Switch to by Veris Industries model H-908 (Split Core).
3. For use with Variable Frequency Drives, use Neilsen-Kuljian, Inc., SENTRY 250 series or equal. The switch shall be split core, with adjustable set point, and a frequency operating range of 6 to 100Hz and LED indication.
4. For fractional horsepower 120 V motors, use "Veris" Industries model Hawkeye 500 series. Provide Switch with adjustable set point (if amp draw is 0.5 and above), HOA switch, relay power LED and sensor calibration LED (if amp draw is 0.5 and above).

B. Current Transducers:

1. Provide a UL listed current transducer with a 4-20mA linear output proportional to the current being measured with an accuracy of $\pm 0.5\%$ or better. Transducer will have reverse polarity protection. Transducer shall be Kele model 4CMA or equal. For currents above 20 Amps, use model SA series – Split core.

2.13 CONTROL DEVICES

A. Control Relays

1. Relays used for interposing or isolation duty shall be of the plug-in environmentally sealed three poles, double throw (3PDT) type with indicator light. Provide one relay type for interchangeability site wide.
2. The relay coil operating voltage shall be that required for the intended duty up to and including 240 V AC and 110V DC at 2 VA. Contact shall be UL rated for 10 amps. Relay shall be Potter & Brumfield Model KUP-14*3 or equal.
3. Suitable plug-in socket shall be of the 11-tab insertion type suitable for 10-amp service. Socket assembly shall have barrier screw terminals and mounting holes.
4. Socket shall have edge tabs for use with a track mounting system. Relays shall be mounted using a track mounting system. Socket shall be Potter & Brumfield Model 27E121 or equal.

B. Timing Relays

1. Time delay relays shall be UL listed, plug-in environmentally sealed with base. The relay coil and timer circuit voltage shall be that required for the intended duty.
2. Time delays both on energizing and/or de-energizing shall be adjustable and required. Furnish each timing relay with LCD status indicator.

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3. For delay break types, indicator shall be off after time out, flashing while timing, and on when output is energized. Timing relays shall be function programmable by pin jumper selections assuming voltages are compatible. Furnish compatible plug-in socket as specified for control relays above.
4. Timing relays shall be OMROM Tateisi Electronics Company solid state timer Model H3CA or equal.

C. Pilot Lights:

1. Provide where required by Sequence of Operation for indication light emitting diodes (LED's). Red, green, blue and yellow LED's shall be used where pilot indicators are required.
2. Assemblies shall be complete to mount in 5/16" diameter holds with locking speed nut. Extended leads as required and external limiting resistor for 120V AC operation. External resistor shall be factory furnished, integrally fastened and secured to wire lead.

D. Potentiometers

1. Provide panel mounted carbon core or plastic film type potentiometers with 4-20mA transmitters where shown or required for manual override control. Wire wound types shall be unacceptable.
2. Product: Allen Bradley 800T or equal.

E. Power Supply:

1. Provide where shown or required DC power supplied with isolated outputs, fold back current limiting and precision regulations. Power supply shall be sized for 200% of the connected load.

F. Air Solenoid (E.P. Valves):

1. Solenoid air valves shall be 2-position electric to pneumatic devices capable of feeding a pneumatic signal through a common port from either a normally closed or normally open port. Select coil voltage as appropriate.
2. Provide Landis & Gyr Model EP265 or an approved equal where capacities are less than 0.3 CFM at 1-psi pressure drop. Provide ASCO Model 8320 for higher flow rates.

2.14 AUTOMATIC CONTROL VALVES

A. General

1. Control valves shall be selected and sized by the BAS manufacturer based on the requirements of this section and the Authority method as described in ASHRAE Handbook (Fundamentals, HVAC Applications and HVAC Systems and Equipment).
2. The valves shall comply with specification section 255500 and 255520 and design drawings for rating and construction.

3. Close-off (Differential) Pressure Rating: Valve actuator and trim shall be furnished to provide the following close off pressure requirements:
 - a. Two-Way Water Valves: 150% of total system (pump) head at the valve location.
 - b. Three-Way Water Valves: 300% of pressure differential between ports A and B at design flow or 100% of total system (pump) head.
 - c. Steam Valves: 150% of operating (inlet) pressure.
 4. Valve body rating shall be equal to the system rating as specified in Division 15.
 5. Select control valves for branch design flow and location on hydronic distribution network. Valves shall be selected, when at design flow, to provide pressure drop of at least 25% of the branch circuit from supply line to the return line. Select valves to be within their range of controllability for each circuit. Valves nearer to pumps on direct return systems will be smaller than line size and provide more system dynamic pressure drop than valves far from the pumps. Obtain campus distribution flow model from the University to confirm system differential pressure available at the building. Submit selected valves in a schedule showing actuator and C_v rating, as well as flow rate, pressure drop, duty, accessories and part numbers for approval.
 6. Control valves and actuators shall be covered by a 5-year manufacturer warranty.
- B. Quality Assurance
1. Belimo shall manufacture valves and actuators unless a required valve is not available from Belimo. Danfoss valves and actuators are accepted as or equal to Belimo
 2. Reheat zone valves shall be "Belimo" Stainless Steel Ball Valves.
 3. Air handler coil valves shall be "Belimo" Stainless Steel Ball Valves.
 4. Bypass valves shall be "Belimo" electronic globe valves with linear characteristics.
 5. Isolation valves shall be "Belimo" electronic butterfly or ball valves 2" to 14" with Belimo or MAR actuators
- C. Cooling and heating coil control shall be fully proportioning throttling type with modulating plugs or characterization discs for equal percentage flow characteristics.
- D. Cooling coil control valves shall be spring return open "NO" and heating coil control valves shall be spring return closed "NC". Other applications shall be as scheduled.
- E. Isolation Valves: ON/OFF, two position control valves shall be line size "Butterfly" or ball type.
- F. Modulating valves (other than heating or cooling coil flow control control) shall be "Globe" or ball type with linear characteristics.
- G. Globe Valves

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1. Valves ½" through 1" shall be constructed with a brass body and screwed ends. Trim (seat, stem and plug) shall consist of a removable cage providing valve plug guiding throughout entire travel range. A stainless steel trim shall be provided. Operator, stem and plug assembly shall be removable for servicing.
 2. Valves 1-1/2" through 2" shall be constructed with a brass body and screwed ends. For special duty, valves may be selected to have bronze or cast iron bodies with screwed or flanged ends. A stainless steel trim (seat, stem and plug) shall be provided.
 3. Valves 2-1/2" and above shall be constructed with a cast iron body and have flanged connections. A stainless steel trim (seat, stem and plug) shall be provided.
- H. Electronic characterized control valves
1. Electronic characterized control valves shall have a TEFZEL flow characterization disk installed at the inlet of the valve. The valve trim, shall utilize a stainless steel ball and stem. Valve body shall be chrome plated forged brass with female NPT threads. Bodies to 1-1/4" shall be rated at 600 PSI and from 1-1/2' to 3" at 400 PSI.
 2. The valves shall have a self –aligning blowout proof stem with dual EPDM O-rings packing design. Fiberglass reinforced Teflon seats shall be used. The valve shall have a four bolt mounting flange to provide a four position, field changeable electronic actuator mounting arrangement.
 3. A non metallic coupling, constructed of high temperature, continual use material shall provide a direct, mechanical connection between the valve body and the actuator. The coupling shall be designed to provide thermal isolation and eliminate lateral and rotational stem forces. Vent hole shall be provided to reduce condensation build-up.
- I. Butterfly valves shall have a cast iron lug body, 304 stainless steel disk, 416 stainless steel shaft, EPDM O-ring, and RPTFE bushings.
- J. Automatic Control Valve Actuators - Belimo
1. The actuator manufacturer shall have ISO 90001 certification and the actuator shall be UL listed under standard 873.
 2. The actuator shall have NEMA type 2 housing and shall be applied in accordance with the manufacturer instructions.
 3. Electric actuators shall consist of a high torque, reversible electric motor coupled through a permanently lubricated reduction gearbox directly to a valve stem coupling. The valve actuator shall provide the maximum torque required for valve close off for the required application
 4. Provide adjustable end of travel switches; one for "OPEN" and one for "CLOSED" which will stop the motor at set valve stem positions.
 5. The actuator shall be modulating with spring return, or two position with spring return as called out in this section, sequence of operation and/or point list.

6. Cooling coil control valves shall be provided with spring return open "NO" actuators and heating coil control valves shall be provided with spring return closed "NC" actuators. Other applications shall be as scheduled.
 7. Upon loss of power or signal the actuator shall close or open under the power of the spring.
 8. Provide a manual de-clutching override to allow manual valve operation without electric power.
 9. Provide integral end (auxiliary) switches to indicate the required position of the valve where required. End (auxiliary) switches shall be "Form C" contacts, enclosed in a watertight housing. If integral ends switches are not available, provide switches as an "add-on" accessory.
 10. All modulating valves shall have a positive feedback signal corresponding to the actual valve position, which can be wired back to the control system.
 11. Each actuator shall have current limiting circuitry or microprocessor overload protection incorporated in its design to prevent damage to the actuator.
 12. Provide a visual position indicator and an attached 3' cable for easy installation to a junction box.
- K. Pressure Gauge Fittings:
1. Provide test gauge ports suitable for the attachment of Schrader fittings. The ports shall be mounted in line together on the back plane of control panel and labeled as to source.
 2. Gauges required by BAS contractor shall be installed only at a test gauge port location by removing the Schrader fitting and installing the gauge. Provide one high accuracy test gauge with 5' of flexible connection tube and connector per control pane to be left in the panels for operator use.

2.15 DAMPER ACTUATORS

- A. Actuators shall be Underwriters Laboratories Standard 873 listed and Canadian Standards Association C22.2 No. 24 certified as meeting correct safety requirements and recognized industry standards and shall be approved for installations in air plenums.
- B. Electronic damper actuators for dampers that are part of a smoke evacuation/pressurization scheme must comply with the requirements of UBC 905.14 "Response Time."
- C. Where smoke control dampers do double duty, i.e. are used for controlling floor static pressures with modulating actuators, provide UL listed actuator with spring return complying with the requirements of UBC 905.14 "Response Time."
- D. Additional Requirements
 1. The actuator shall be direct coupled over the shaft, enabling it to be mounted directly to the damper shaft without the need for connecting linkage. The fastening clamp shall be of a "V" bolt design with associated "V" shaped, toothed cradle attaching to the

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shaft for maximum strength and eliminating slippage. Spring return actuators shall have a "V" clamp assembly of sufficient size to be directly mounted to an integral jackshaft of up to 1.05 inches when the damper is constructed in this manner. Single bolt or setscrew type fasteners are not acceptable.

2. The actuator shall have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the rotation of the actuator. Mechanical end switches or magnetic clutch to deactivate the actuator at the end of rotation are not acceptable.
3. For power-failure/safety applications, an internal mechanical, spring return mechanism shall be built into the actuator housing. Non-mechanical forms of fail-safe are not acceptable.
4. All spring return actuators shall be capable of both clockwise and counterclockwise spring return operation by simple changing the mounting orientation.
5. Proportional actuators shall accept a 0-10 VDC or 0-20 mA control signal and provide a 2-10 VDC or 4-20 mA operating range. An actuator capable of accepting a pulse width modulating control signal and providing full proportional operation of the damper is acceptable.
6. All 24 VAC/DC actuators shall operate on Class 2 wiring and shall not require more than 10 VA for AC or more than 8 watts for DC applications. Actuators operating on 120 VAC power shall not require more than 10 VA. Actuators operating on 230 VAC power shall not require more than 11 VA.
7. All proportional actuators shall have an external, built-in switch to allow the reversing of direction of rotation.
8. Actuators shall be provided with a conduit fitting and a minimum three-foot electrical cable and shall be pre-wired to eliminate the necessity of operating the actuator housing to make electrical connections.
9. Actuators shall be design for a minimum of 60,000 full stroke cycles at the actuator's rated torque and shall have a 5-year manufacturer's warranty, starting from the date on installation. The manufacturer shall be ISO9001 certified.
10. Electronic damper actuators shall be as manufactured by Belimo or JCI.

2.16 ENCLOSURES

- A. Enclosures shall be rated and comply with the standards of The National Electrical Manufacturers Association (NEMA) as specified herein:
 1. NEMA 1 – General Indoor Location
 2. NEMA 3 - Outdoor
 3. NEMA 4 – Wet locations (Central Plant, pump rooms...)
 4. NEMA 12 – Plenums

2.17 TSI PRESSURE MONITOR & SENSOR

- A. The room pressure monitor system shall be completely independent for each individual patient room. The room pressure monitor system shall not depend on measurements from other patient room monitor systems.
- B. The room pressure monitor system shall measure the pressure differential between the patient room and reference space. The room pressure sensor shall have a resolution of 5% of the measured value and shall detect any change in the room pressure within 0.1 second, with a minimum reading of 0.00001 inches H₂O.
- C. The room pressure monitor system shall accept one to three pressure sensor input. The primary sensor shall measure the pressure differential between the patient room and corridor.
- D. Each monitor shall have a full color touch screen interface with a minimum touchscreen size of 4.3 inches. Screen shall be capable of displaying multiple colors at one time. The monitor shall be capable of displaying room mode, alarm status, user-configurable room label and all measurements connected on a single screen without scrolling. Displays that change the backlighting color or external LEDs to indicate alarm status are not acceptable. Monitors that use keypads are not acceptable.
- E. Local audible and visual alarms and relay contacts shall be enabled whenever either measured room pressure differential falls below its user configurable low alarm set point or rises above its user configurable high alarm set point, after a configurable delay. The pressure sensor shall have individual alarm set points for high and low alarms. A mute function shall temporarily silence the audible alarm for a user configured delay. Manual or automatic reset of the alarms shall be configurable.
- F. The room pressure monitor will use the flow station to calculate the Air Changes per Hour ventilation rate for the patient room. Local audible and visual alarms shall be enabled whenever the measured air volume falls below its configurable low alarm set point, after a configurable delay. Supply and exhaust flows shall have individual alarm set points. The audible alarm shall have a mute function to temporarily silence the alarm for a user-configured delay. Manual or automatic reset of the alarms shall be configurable.
- G. The room pressure monitor system shall have Positive Mode, Negative Mode and No Isolation Mode. Users can change room mode either with an input from a keyswitch or through the touchscreen without accessing the full menu system. The keyswitch or touchscreen shall change the room mode from Positive Mode or Negative Mode to No Isolation Mode (and back), allowing the room to be used for standard patient care. In No Isolation Mode, the room pressure monitor will disable all alarms.
- H. Calibration of room pressure differential and air flow shall be done electronically through the use of the integral keypad. Calibration shall consist of adjusting the sensor zero point and sensor span to match a reference measurement. Password protection of the calibration items shall limit unauthorized access. Neither remote calibration nor calibrating through the use of potentiometers is acceptable.
- I. The room pressure monitor shall have the ability to communicate with a building automation system (BMS) via Modbus, BACnet® MS/TP communication protocols.

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- J. The room pressure sensor shall be bi-directional with an accuracy of 10% of reading. The sensor shall be capable of being mounted in the corridor (reference space) or the patient room (controlled space). The room pressure sensor shall use two in-line ceramic coated RTDs to measure the pressure differential. The room pressure sensor shall be temperature compensated over a range of 55°F to 95°F. Sensors employing a thermistor-based sensor or that cannot differentiate between positive and negative pressures are not allowed. Field-calibration of the sensor shall be performed through the touchscreen on the room pressure controller.
- K. Acceptable manufactures: TSI, JCI

2.18 INCIDENTAL WORK

- A. The BAS installer shall inspect the installation of the following equipment and devices provided under other sections.
 - 1. Work included as part of Sections Sections 230523 and 232113:
 - a. Installation of automatic valves, separable wells specified to be supplied by the BAS manufacturer.
 - b. All necessary pressure taps, drain and overflow connections, piping, tubing and valves related to BAS instrumentation and devices.
 - 2. Work included as part of Sections 233300 and 233400:
 - a. Furnish and install all automatic dampers and provide necessary blank off plates or transitions required for dampers that are smaller than duct size.
 - b. Assemble multiple section dampers with required interconnecting linkage and extend required number of shafts through duct for external mounting of damper motors.
 - c. Provide necessary sheet metal baffle plates to eliminate stratification and provide air volumes specified. Locate baffles by experimentation and fix seal permanently in place only after stratification problems have been eliminated.
 - d. Provide access doors or other approved means of access through ducts for service to equipment.
- B. Air Handler Devices: Installation of control devices associated with air handlers including but not limited to damper actuators, temperature and pressure sensors shall be provided for mounting at the air handler unit factory where applicable. All cost associated with shipping the devices furnished under this section, to the air handler unit manufacturer shall be borne by the BAS contractor.
- C. Interface with Chiller Controls
 - 1. Refrigeration chillers are furnished with integral translator panels for direct interface with BAS.

2. Chiller Start/Stop, Status, Temperature reset and demand-limiting functions shall be accomplished using hardwired points directly from the BAS to the chiller interface control panel. All other functions shall be via the data link (BACnet). Coordinate with chiller manufacturer all the hardware and software requirements for a complete interface as specified.

2.19 INSPECTION OF CONDITIONS

- A. Examine all related work and surfaces before starting work of this Section. Report to the Architect, in writing, conditions which will prevent proper installation of this work. Beginning of work of this section without reporting unsuitable conditions to the Architect constitutes acceptance of conditions. Perform any required removal, repair or replacement of this work caused by unsuitable conditions at no cost to the Owner.

END OF SECTION 255530

SECTION 26 05 00

ELECTRICAL GENERAL REQUIREMENTS

PART 1 - 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 Section 260519 of these specifications 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 22 and 23 including installation and connection of all relays, remote starters, etc. and the connection of all motors and controllers. Control wiring for Division 22 and 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 22 and 23. 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 22 and 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 Section 01 41 00 – 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:

- 1. 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.
- 2. Refer to the individual sections for identified equipment and materials for which submittals are required.
- 3. Refer to Division 1 for required procedures.

B. Operation and Maintenance Data and Instruction:

- 1. Refer to Division 1 for detail requirements.
- 2. Printed Material: Provide required printed material for binding in operation and maintenance manuals.
- 3. 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 2 - 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 Specification Section 01 33 23. 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 a Nationally Recognized Testing Laboratory (NRTL).
- 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 contractor; 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.
 - 1. Security Cameras and camera mounts.

PART 3 - EXECUTION

3.1 ELECTRICAL SYSTEMS OPERATIONAL TESTS, MANUFACTURERS SYSTEMS CERTIFICATION AND DESIGN AUTHORITY ASSISTANCE

- A. Commissioning The project will have selected building systems commissioned. The equipment and systems to be commissioned are specified in Section 01 91 13. The commissioning process is described in Section 01 91 13.

3.2 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.
 - 1. 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:
 - 1. Install minimum 4" high concrete pads or as indicated. Other pad dimensions shall be as required to accommodate the equipment installed.
 - 2. Use 3,000 PSI (14 Kg/s/mm) concrete.
 - 3. Reinforce with 6" x 6" W2.9 x W2.9, 10GA (3.4mm) mesh, with short dowels into floor at 12" OC around perimeter.
 - 4. Chamfer top edges 3/4" (18mm).
 - 5. Make all faces smooth.
 - 6. Set anchor bolts for equipment. Consult with user.
 - 7. Coordinate the size of all pads, the location of all anchor bolts, and the location of all vibration isolators.

3.3 QUALITY ASSURANCE AND PROJECT SAFETY

- A. Provide quality assurance and project safety programs. Satisfy the minimum acceptable requirements provided in the specifications.

3.4 PREPARATION

- A. Examine Drawings and Site; be familiar with types of construction where electrical installation is involved.
 - 1. 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:
 - 1. Refer to Division 1 for submittal requirements.
 - 2. Provide a schedule of values for the electrical work specified under Division 26. Include separate labor and material itemization for each line item requested. The itemized schedule of values will be used to determine project completion and progress for payment requests, including overhead and profit for each itemization. Schedule of values must be submitted and approved prior to first pay request. Provide the following line items as a minimum level of itemization:
 - a. Electrical service and distribution (include all power equipment, i.e., panelboards, transformers, feeders, motor controllers, etc.).
 - b. Lighting systems (include all fixtures, lamps, branch circuiting, and lighting controls).
 - c. Devices (include all power outlets and branch circuit wiring not associated with lighting, motors, or equipment connections).
 - d. Equipment connections (include all wiring and connection to HVAC, elevators, etc., including controlling devices and feeders).
 - e. Basic work and materials (include work common to all systems, i.e., backboards, cutting and patching, demolition, temporary services, record drawings, permits, etc.).
 - f. Special systems (itemize separately, including emergency power supply system, grounding system, UPS equipment, etc.).
 - g. Communications/signaling systems (include all low voltage systems, itemized separately, i.e., fire alarm, sound paging, security, etc.).

3.5 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.
 - 1. 36" @ 250V and less.
 - 2. 42" @ 250V to 600V.

3.6 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.

3.7 CARE AND CLEANING

- A. 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 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.
- B. 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.
- C. Clean light fixtures and lamps thoroughly, just prior to final inspection. Fixture enclosures, shielding, etc., shall be cleaned by an approved method.
- D. 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.

- E. Unless indicated on the drawings or specified herein to the contrary, all painting shall be done under the PAINTING Section of these Specifications.
- F. Where plywood backboards are used to mount electrical equipment provided under Division 26, paint backboards with two coats of light gray semi-gloss fire retardant paint under Division 26.
- G. Plywood, Mounting Backboard for Communications Equipment - Plywood mounting backboard shall extend ceiling-to-floor (10'), unless otherwise specified. Mount plywood to cover the entire area on which connecting hardware and cable management hardware may be mounted. Mounting board shall be AC-grade or better, void-free plywood, with a minimum thickness of 19 mm (¾").
 - 1. Two-coats of FR-S fire-retardant rated paint shall be applied to all exposed surfaces. The plywood-rating stamp shall be left exposed for inspection purposes.
 - 2. Securely fasten plywood to wall-framing members. Use flush hardware and supports to mount plywood.
 - 3. Ensure that the strength and placement of the hardware are sufficient to handle the total anticipated load (static and dynamic) and mounting of cabling components.
- H. 4 Color of paint shall be WHITE.
- I. All broken, damaged or otherwise defective parts 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.

3.8 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.

3.9 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.

3.10 PROTECTION

- A. In performance of work, protect work from damage. Protect electrical equipment, stored and installed, from dust, water or other damage.

3.11 EQUIPMENT IDENTIFICATION

- A. Panelboards, remote control switches, terminal boxes, etc., shall be properly identified according to section 260553 of these specifications.

3.12 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.

3.13 ELECTRICAL SYSTEMS OPERATIONAL TESTS, MANUFACTURERS SYSTEMS CERTIFICATION AND DESIGN AUTHORITY ASSISTANCE

A. Testing:

1. 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.
2. Refer to the individual specification sections and Section ~~26960~~ 26 90 90 of the specifications for test requirements.
3. 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.
4. All electrical systems shall be tested for compliance with the specifications.

B. Manufacturers Certifications:

1. 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.

2. 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
3. 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

3.14 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.

3.15 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.

3.16 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 05 00

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 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 manufacturers which conform to this specification are acceptable.
1. Hydraulically applied conductor terminations:
 - a. Scotch (3M)
 - b. Thomas and Betts (T&B)

- c. or equal
- 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.

1.3 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 vaportight 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 torquing 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. Terminate conductors No. 10 AWG and smaller specified in Division 26 to be stranded, with crimp type lug or stud. Direct termination of stranded conductors without crimp terminator to terminal screws, lugs, or other points is not permitted even if terminal is rated for stranded conductors. Crimp terminal shall be the configuration type suitable for terminal point.
- K. Make connections between fixture junction box and fixture with fixture wire.
- L. Control, communications or signal conductors shall be installed in separate raceway systems from branch circuit or feeder raceway, unless indicated otherwise on the drawings.
- M. Conductor lengths for parallel circuits shall be equal. Do not configure isolated phasing in separate conduits for parallel conductors.
- N. Install a minimum of twelve inches (300 mm) of slack conductor at each outlet.

- O. Thoroughly clean conductors prior to installing lugs and connectors.
- P. 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.
- Q. All cables and wires passing through manholes and handholes shall be full looped inside the manhole and handhole and supported on galvanized steel racks.

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 20
ELECTRICAL CONNECTIONS FOR EQUIPMENT

PART I - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Electrical Connections to equipment specified under other sections or as shown on drawings.

1.02 SUBMITTALS

A. None Required.

1.03 REFERENCE STANDARDS.

- A. Underwriters Laboratories.
- B. NEMA WD5 – Specific Purpose Wiring Devices.

1.04 QUALITY ASSURANCE

- A. Field verify equipment rating with manufacturers nameplate data. Adjust feeders and overcurrent protectors as required to comply with code requirements.

PART II - PRODUCTS

2.01 LUGS

A. Acceptable Manufacturers.

1. Burndy Corporation.
2. ILSCO Corp.
3. Or Equal

B. Compression Type: Seamless, one piece, copper, size per conductor applied to, two NEMA Drill.

C. Set Screw Type: Pin type compression fittings for use on #2 AWG and larger conductor sizes, barrels filled with conductive paste.

2.02 CRIMP ON TERMINALS

A. Acceptable Manufacturers

1. Thomas-Betts
2. 3M

3. Or Equal

B. Crimp on, insulated terminals for use on #14 AWG thru #10 AWG conductor size, flanged fork or ring torque style.

2.03 CONNECTORS, SPLICES AND TAPS

A. Acceptable Manufacturers

1. Burndy

2. ILSCO

3. Or Equal

B. Compression or set screw type with insulating cover for use on #8 AWG and larger conductor.

C. Split bolt connectors with insulating covers for use on #6 AWG and larger conductor.

2.04 WIRE CONNECTORS

A. Acceptable Manufacturers

1. Ideal Industries

2. Buchanan

3. Or Equal

B. Conical spring type with nylon or plastic outer shell, color coded to denote wire size, for use on #14 AWG thru #10 AWG conductors.

C. Butt Compression style insulating crimp splices for use on #14 AWG and smaller conductors.

PART III - EXECUTION

3.01 INSTALLATION

A. Bus Connection: Use compression lugs, bolt to bus bars using cap screws, lock washers and nuts of material electrically compatible with bus.

B. Set Screw Connection: Install pin type compression fitting of similar construction as compression lugs.

C. Terminations to Motors: Use crimp on connectors for motor terminations from stranded conductors and where terminal lugs are not provided by equipment supplier. Use ring-tongue terminals where ever possible.

D. Use connector manufacturer approved crimping tool to install connectors. Do not remove conducting strands or oversize connector. Apply insulating tape over exposed conductor to 150% of conductor insulating material.

- E. Tighten connections to ensure maximum surface contact between terminals.
- F. Strip insulation per manufacturers instructions, use conductive paste where required.
- G. Install electrical connections as indicated; in accordance with equipment manufacturer's written instructions and with recognized industry practices.
- H. Coordinate with other work, including wires, cables, raceway and equipment installation, as necessary to properly interface installation of electrical connections for equipment with other work.
- I. Trim cables and wires as short as practicable and arrange routing to facilitate inspection, testing and maintenance.
- J. Fasten identification markers to each electrical power supply conductor which indicates their voltage, phase and feeder number in accordance with Electrical Identification section. Affix markers on each terminal conductor, as close as possible to the point of connection.

3.02 INSPECTION

- A. Inspect area and conditions under which electrical connections for equipment are to be installed. Do not proceed with the work until conditions are acceptable for terminations.

3.03 FIELD QUALITY CONTROL

- A. Upon completion of installing of electrical connections, and after circuitry has been energized with rated power source, test connections to demonstrate capability and compliance with requirements. Ensure that direction of rotation of each motor fulfills requirements. Correct malfunctioning units at site, then retest to demonstrate compliance.
- B. 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.
- C. Provide documentation of all tests as specified by this and other sections in the following formats. Submit in an electronic form (2 copies) and in hard paper form (2 copies). Submit interim test reports to the University's Representative and 'final' acceptance test reports (where only one test iteration is required consider it be the 'final') to the prime electrical contractor (for a single, consolidated submission of all electrical test and O&M's to the University). Compile the electronic copies (including graphics or drawings) entirely in the current version of Acrobat Abode 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).
- D. All electrical systems testing (power and low voltage) as described by each central collection point for all test documentation, whether the tested systems were provided and installed under his contract or not. All Division 16 contractors and vendors are required to cooperate with the prime electrical contractor in this regard and the single submission of tested results shall be considered a contract requirement of all contractors and vendors for all electrical, communication, data, etc. work performed under Division 16.
- E. Provide a copy of the test documentation with the O&M Manual submission.

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END OF SECTION 26 05 20

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ELECTRICAL CONNECTIONS FOR EQUIPMENT
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SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART I - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Power System Grounding.
 - 2. Communications System Grounding.
 - 3. Electrical Equipment and Raceway Grounding and bonding.

1.02 REFERENCE STANDARDS

- A. National Electrical Manufacturers Association (NEMA).
- B. American National Standards Institute (ANSI).

PART II - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Oz Gedney.
- B. or equal

2.02 MATERIALS

- A. Ground Clamp: Water pipe connection, bronze two-piece with serrated jaws, lug sized for grounding electrode conductor.
- B. Connectors, Compression Type: Bronze or Copper, pretreated with conductive paste, sized for conductor to which applied.
- C. 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.

2.03 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.

PART III - EXECUTION

3.01 GENERAL BRANCH CIRCUITS AND FEEDERS

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- 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 green grounding conductor in all conduits, including 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 grounding conductors per CEC 250 unless a larger ground is indicated on the drawings. Secure grounding conductors using approved methods to each pull box, junction box, and equipment housing.
- C. All panelboards, junction boxes, pullboxes, wireways and equipment enclosures shall be bonded to the conduit systems.
- 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.

3.02 MOTOR CIRCUITS

- A. All motor circuits shall have a ground wire pulled with the phase conductors. The ground wire shall be extended from the panel ground bus and shall be bonded at all junction boxes, pullboxes, disconnect switches, controllers, motor connection boxes, and motor frames. Each motor with a Variable Frequency Drive controller shall have a dedicated grounding conductor. Ground these motors back through the VFD controller as recommended by the drive manufacturer to eliminate radio frequency interference. Also, the wiring between the VFD controller and the motor shall be in a dedicated conduit.

3.03 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 cable sized according to Table 250-94(a) 250.102(C)(1) of the California Electrical Code. Extend separately derived insulated ground to the transformer in rigid steel conduit.

3.04 EQUIPMENT ROOM GROUND TERMINAL BAR

- A. Mount bar by anchors and bolts using 1-1/2" long segments of 1/2" rigid conduit as spacer between bar and wall. Use a minimum of two supports, 18" on center. Connect all grounding electrode system conductors, system enclosure ground bus, and other indicated electrode systems to the terminal bar. Each telecom/his room shall have a ground bar with a minimum of six lugs or screws. Interconnect telecom/his ground bars to building steel with No. 6 AWG insulated copper conductor.

3.05 FLEXIBLE RACEWAY GROUNDING

- A. Install a ground conductor inside all flexible raceways (e.g. flexible steel, liquid tight). Bond the conductor to the enclosure or ground bus in the nearest box or access on either side of the flexible section. Size conductor as specified, indicated or required by code, whichever is larger.

3.06 SECTIONAL RACEWAY

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GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
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- 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.

3.07 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. Connector shall be as manufactured by Burndy Engineering Company, IlSCO Corporation, or equal. 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.

END OF SECTION 26 05 26

SECTION 26 05 29
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART I - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Conduit and equipment supports.
 - 2. Fastening hardware.
 - 3. Vibration Isolation.

1.02 SUBMITTALS

- A. Submit for each isolator, complete manufacturer's description including quantity loading and static deflection.

1.03 REFERENCE STANDARDS

- A. American Plywood Association. (APA)
- B. Underwriters Laboratories. (UL) "Building Materials Directory".

1.04 QUALITY ASSURANCE

- A. Support systems shall be adequate for weight of equipment and conduit, including wiring, which they carry.

PART II - PRODUCTS

2.01 SUPPORT CHANNELS

- A. Acceptable Manufacturers – Support Channels
 - 1. Unistrut
 - 2. Super Strut
 - 3. Or Equal
- B. Support Channel: 12-gauge galvanized or painted steel, "U" section, 1-½" square nominal in section.
- C. Hardware: Manufacturer's standard as required to support equipment. Provide corrosion resistant finish.

2.02 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.

2.03 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.

PART III - EXECUTION

3.01 INSTALLATION

- A. Fasten hanger rods, conduit clamps, outlet and junction boxes to building structure using bolts, beam clamps, and spring steel clips.
- B. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; expansion anchors in solid masonry walls; self-drilling anchors or expansion anchor on concrete surfaces; sheet metal screws in sheet metal studs; and wood screws in wood construction.
- C. Do not fasten supports to piping, ductwork, mechanical equipment, other conduit, or roof deck.
- D. Install all support devices according to manufacturers guidelines and recommendations.
- E. Do not drill through structural framing members.
- F. 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.
- G. Install freestanding electrical equipment on concrete pads four inches high and overlapping equipment footprint by two inches on all sides.
- H. Install surface-mounted cabinets and panelboards with minimum of four anchors. Provide steel channel supports to stand cabinet one inch off wall, or on $\frac{3}{4}$ " plywood backboards.
- I. Install plywood backboards over gypsum board or directly to stud framing as indicated. Fasten to studs with self-tapping screws according to APA recommendations.
- J. 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.
- K. 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.
- L. 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.

- M. 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 32
PULL BOXES AND JUNCTION BOXES

PART I - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Interior Pull and Junction Boxes
 - 2. Exterior Pull and Junction Boxes.

1.02 SUBMITTALS

- A. None Required.

1.03 REFERENCES

- A. Underwriters Laboratories (UL)
- B. National Electrical Manufacturers Association (NEMA) #250 - Enclosures for Electrical Equipment (1000 volts maximum).

PART II - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. O.Z. Gedney; General Signal
- B. Hoffman
- C. Or Equal

2.02 PULLBOXES AND JUNCTION BOXES

- A. Indoor general purpose boxes shall be a NEMA 1 enclosure, constructed of code gauge galvanized steel. The boxes shall be constructed from a single piece of steel with folded and welded corners. The boxes shall have a flat removable, galvanized sheet metal cover held in place with binder head sheet metal screws. Supply boxes with no knockouts.
- B. Outdoor boxes shall be cast iron with a plain cast iron cover. Covers shall be neoprene gasketed and shall be NEMA 4 watertight construction. The cover shall be held in place by stainless steel screws. The cart wash and waste management areas shall be considered outdoor locations.
- C. Size boxes by code requirements related to the number and size of conduits and wire entering the box.
- D. Boxes recessed in earth or concrete, use an outside flanged recessed cover box. Outdoor boxes mounted on surface, use an unflanged box.

- E. Conduit openings shall be bossed, drilled and tapped in outdoor boxes.
- F. Standard size metal boxes stamped from galvanized steel shall be used for indoor general purpose where size and capacity are acceptable by code.
- G. Boxes shall be of the depth required for wiring capacity. Boxes shall be cast iron with threaded hubs for vaportight and wet locations.
- H. Boxes for hazardous (classified) locations shall be approved for the classification and use.
- I. Provide boxes with a blank cover.
- J. Underground pull-boxes shall be high-density reinforced concrete with end and side knock-outs. All pull-boxes shall be back filled with concrete. Each pull-box shall be equipped with the following reinforced concrete accessory:
 - 1. 10" extension
 - 2. Slab
 - 3. Lid with hold down bolts and labeled with usage. (Steel checker plate with hold down bolts in traffic areas.)

PART III - EXECUTION

3.01 INSTALLATION

- A. Pull boxes and junction boxes required are not shown on the plans; however, they shall be provided to meet Code requirements and improve ease of wire pulling. Provide pull boxes or junction boxes in conduit runs over 90' long or when more than 4 quarter bends occur in a conduit run. Boxes shall be sized to meet CEC requirements.
- B. Mount all pullboxes and junction boxes securely to the building structure. Boxes shall not depend on conduit for support.
- C. Install pullboxes and junction boxes such that covers are accessible. Do not install in finished areas unless approved by University's Representative.
- D. Cut or sheared edges shall be filed or honed, eliminating all sharp edges.
- E. Pullboxes and junction boxes shall be installed with unused or open knockouts plugged.
- F. Install pullboxes direct buried in earth or concrete flush with surface, square with surrounding structures.
- G. All junction boxes shall be labeled on cover indicating circuit number and panel number and all wires shall be labeled in junction boxes with circuit numbers.

END OF SECTION 26 05 32

**SECTION 26 05 33
RACEWAYS**

PART I - GENERAL

1.01 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.

1.02 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
 - 2. American National Standards Institute (ANSI):
 - 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

- c. or equal
- 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.

1.03 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 II - PRODUCTS

2.01 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 1/2". The size of all conduits shall be in accordance with the CEC using 30 fill, 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 O /Gedney type R, or equal (Or equal, no known equal.)
- F. Expansion and deflection fittings shall be O /Gedney, type DX, or equal
- G. All under floor/ground raceways will be cleaned and mandrilled before wire is installed.

2.02 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.

2.03 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. Setscrew 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.

2.04 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° 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.

2.05 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.

2.06 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 1/2" 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 1/2" threaded steel rod for individual conduits 1.5" and smaller and 3/8" 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.

2.07 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 1/2" 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.

2.08 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 1/2" deflection, expansion, or contraction in any direction and shall allow 30° 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 firewall partition rating.

PART III - EXECUTION

3.01 INSTALLATION

- A. General
 - 1. Conceal all conduits, except in unfinished spaces such as equipment rooms or where indicated by symbol on the drawings or as approved by the University's Representative. Run concealed in areas having finished ceilings and furred walls. Run all cross conduits and vertical risers or drops concealed in wall and/or partitions. Run vertical risers or drops up or down between wall studs. Should it be necessary to notch any framing members, notch only at locations in a location and manner approved by University's Representative.
 - 2. Exposed conduit below 8'-0" shall be rigid type.
 - 3. Provide flexible connections of short length to equipment subject to vibration or movement and to all motors. Provide a separate bonding conductor in all flexible connections.
 - 4. Support conduits per seismic guidelines.
 - 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.

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8. Flattened, dented, or deformed conduits are not permitted and shall be removed and replaced.
9. Secure rigid conduit i.e., rigid galvanized conduit and intermediate metal conduit, to sheet metal enclosures with two (2) locknuts and insulated bushing. Secure EMT to sheet metal enclosures with insulated throat connectors.
10. Fasten conduit support device to structure with wood screws on wood, toggle bolts on hollow masonry, anchors as specified on solid masonry or concrete, and machine bolts, clamps, or spring steel clips, on steel. Nails are not acceptable.
11. Protect conduits against dirt, plaster, and foreign debris with conduit plugs. Plugs shall remain in place until all masonry is complete. Protect conduit stud-ups during construction from damage; any damaged conduits shall not be used.
12. Seal all conduits originating from outside building from below grade, all conduits entering refrigerated spaces, i.e., freezers and coolers, and all conduits entering exterior mounted electrical equipment with insulating electrical putty to prevent entrance of moisture. Waterproofing material shall not contain creosote or polysulfides which are not compatible with the waterproofing system.
13. Install conduit with wiring, including homeruns as indicated on the drawings. Any change resulting in a savings in labor or materials is to be made only in accordance with a contract change. Deviations shall be made only where necessary to avoid interferences and when approved by University's Representative by written authorization.
14. Where conduit passes through finished walls or ceilings, provide steel escutcheon chrome plates or paint as directed.
15. Provide sleeves for conduit passing through floor slabs and/or concrete masonry walls.
16. Conduits which penetrate roof membranes shall be installed in accordance with manufacturer's recommendations and architectural specifications.
17. Separate raceway systems are to be installed for power systems and for control, signal and communications systems. Do not install control, signal or communications cables in the same raceways as branch circuit or feeder cables, unless indicated otherwise on the drawings.
18. Provide expansion fitting in all conduits where length of run exceeds 200' or where conduits pass building expansion joints.
19. Telephone, and 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:

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- 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 or block walls, in concrete vaults, 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' 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. Above In
 - d. suspended or accessible ceilings above 8'.
 - e. Exposed in dry locations above 8 feet where not subjected to mechanical damage.
 - f. In furred ceiling spaces.
 - g. For fire alarms system conduit. Paint red 6" wide every eight feet.
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, expansion joints, and flush mounted lighting fixtures. Conduit must be secured.
 - a. Flexible conduit used for connection of motor, dry type transformers, electric duct heaters, and unit heaters, shall not exceed 18" in length.
 - b. Flexible conduit from outlet box to flush mounted lighting fixture shall not exceed 6 3 feet in length.
 - c. Maintain ground continuity through flexible conduit with green equipment grounding conductor; do not use flexible conduit for ground continuity.
 - d. Liquid tight conduit shall be used to connect equipment in mechanical equipment rooms and exterior installations, and for final connections to all equipment containing water or other liquid service.
 - 7. Service entrance conduits shall be installed "outside" of the building as defined by the CEC. Provide concrete encasement where required.
 - 8. No conduit requiring cutting of cross-webs of concrete masonry units is permitted. Conduit shall be threaded through cells or concrete masonry units lowered around conduit. Neither horizontal joint reinforcement nor bond beam reinforcement shall be cut for conduit installation.
 - 9. Where hazardous locations, as classified by the California Electrical Code, exist, all conduits and fittings and the installation of these materials shall comply with Article 500 of the California Electrical Code.
 - 10. LB condulets for conduits larger than 1- $\frac{1}{2}$ " 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 18" 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. Conduit shall be run following the most direct route between points and the route shall be coordinated with other disciplines.
- g. 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 $\frac{1}{8}$ " 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.
- h. 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.
- i. 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 $\frac{1}{3}$ 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". 3".

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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' and within 3' 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 trapezoidal 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' with conduit beam clamps, one hole conduit straps or trapezoidal 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 Section 09900 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 firewalls 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- $\frac{1}{2}$ " 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.

3.02 ADJUSTMENT, CLEANING AND PROTECTION

- A. Clean: Upon completion, clean all installed materials of paint, dirt, and construction debris. All conduit systems shall be cleaned of water and debris prior to the installation of any conductors.

END OF SECTION 26 05 33

**SECTION 260535
ELECTRICAL BOXES AND FITTINGS**

PART I - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Pressed Steel Boxes and Fittings.
 - 2. FS and FD Boxes.

1.02 SUBMITTALS

- A. None required.

1.03 REFERENCE STANDARDS

- A. Underwriters Laboratories (UL).
- B. National Electrical Manufacturers Association (NEMA) #250 - Enclosures for Electrical Equipment.
- C. NEMA 051 - Sheet steel outlet boxes, device boxes, covers and box supports.
- D. NEMA 052 - Non-metallic outlet boxes, covers and box supports.

PART II - PRODUCTS

2.01 STEEL BOXES AND FITTINGS

- A. Acceptable Manufacturers:
 - 1. Midwest Electric
 - 2. RACO
 - 3. or equal
- B. Boxes to be non-gangable, having knockouts as required and compatible covers or extension rings suitable for installed devices.
- C. Boxes to be galvanized stamped steel, with grounding lug tapped hole.
- D. Provide 3/8" fixture studs in ceiling outlet boxes where required.

2.02 FS AND FD BOXES

- A. Acceptable Manufacturers:

1. Appleton
 2. Crouse - Hinds
 3. or equal
- B. Provide cast iron alloy boxes with epoxy paint or galvanized finish. Aluminum or pot metal boxes are not acceptable. Boxes shall have threaded hubs sized for conduit without adapters and threaded holes for securing cover. Device boxes shall be provided with proper weatherproof, gasketed cover assemblies, junction and pull boxes shall be provided with flat gasketed covers. Fixture boxes shall be 4" round or as required for the fixture. Junction and pull boxes requiring more than one gang shall be multi-gang FS or FD or dimensioned cast boxes with cast covers.

PART III - EXECUTION

3.01 GENERAL

- A. Install all boxes so they are completely covered by the wall plate or fixture.
- B. Provide galvanized one-piece or welded pressed steel boxes and fittings unless indicated otherwise. Provide galvanized steel outlet box covers for surface mounted galvanized steel boxes in unfinished areas. Boxes in unfinished areas, installed exposed, shall be cast type "conduit" for switches and convenience outlets. Exposed boxes mounted below 8' from finished floor shall be cast type. Provide blank cover for all boxes without fixture or device.
- C. Provide FS and FD boxes and required covers surface mounted in damp or wet locations and as indicated on plans. Boxes shall be securely mounted using mounting lugs or other method made in a way so as not to degrade the weatherproof nature of the system.
- D. Install all outlet boxes rigidly, plumb, and level. Secure outlet boxes to ceiling system support members and wires using only clips designed and approved for the purpose. Do not cut insulation in outside walls to install outlet boxes. Do not use through-the-wall boxes unless specifically noted. Do not install boxes back-to-back in adjoining rooms. Offset outlet boxes installed back-to-back in fire-rated walls and partitions a minimum of 24 inches horizontally. Protect boxes during construction to prevent entrance of foreign materials such as concrete, mortar, plaster, paint, etc.
- E. Flush mounted boxes shall be installed with opening edge flush with finish surface.
- F. Pull boxes shall be provided in all runs of 90' or more in length or such that not more than four 90° bends occur between boxes. Junction and pull boxes shall be located in accessible locations and shall be concealed in finished work and shall be permanently identified with system label. Where concealed accessible space is not available in finished areas, boxes shall be flush mounted with rings and blank plates at standard boxes, flanges and plaster stops at large boxes. Flush boxes shall be carefully aligned to be plumb. Locations to be coordinated with University's Representative prior to installation.
- G. 4" octagonal boxes or square boxes with plaster rings shall be used for ceiling or wall light fixture outlets. Boxes for fixtures shall be equipped with fixture studs. Boxes shall be supported as required to carry loads as required by code. Other ceiling outlets shall

be 4" square or larger with plaster rings unless indicated otherwise on drawings. Boxes shall be flush mounted or concealed in finished construction.

- H. Provide minimum of $\frac{3}{4}$ " plaster rings designed for the purpose for outlet boxes in plaster or gypsum board walls.
- I. Provide masonry boxes and extension rings for boxes in concrete block, brick, and glazed tile walls. Secure with auxiliary plates, bars or clips and grout in place.
- J. Install outlet device mounting rings such that they extend no more than $\frac{1}{16}$ ", or are recessed no more than $\frac{3}{16}$ " from wall surface.
- K. Support all outlet boxes independently from the raceway systems. Securely support by adequate wood backing or by manufactured adjustable channel type heavy-duty box hangers. Boxes with metal box hangers shall be attached to metal studs. Box hangers shall be securely tied or welded (where permitted) to metal studs. Paint weld with rust inhibitor.
- L. Install outlet boxes for electric water coolers concealed inside cooler cabinets. Locate outlet boxes as recommended by equipment supplier.
- M. For dimensional locations of the actual installed location shall not vary from the dimensioned location by more than plus or minus one-half inch, unless otherwise noted.
- N. Boxes for local switches shall be at least 1- $\frac{1}{2}$ " deep 4" square for 1 or 2 gang switches, with switch plaster rings and gang box with gang cover.
- O. Boxes for telephone and data shall be minimum 2- $\frac{1}{8}$ " deep.
- P. Use screws and not nails to support outlet boxes.
- Q. Nails shall not be used to support outlet boxes. Boxes must be accurately placed for finish, independently and securely supported by adequate wood backing or by manufactured adjustable channel type heavy-duty box hangers. Boxes with metal box hangers shall be attached to metal studs. Box hangers shall be securely tied or welded (where permitted) to metal studs. Paint weld with rust inhibitor. Boxes installed in masonry, tile, or concrete block construction shall be secured with auxiliary plates, bars or clips and be grouted in place.

END OF SECTION 260535

**SECTION 26 05 37
FLOOR BOXES**

PART I - GENERAL

1.01 SUMMARY

- A. Scope: Provide complete UL listed floor outlet assemblies for power, telephone, data and special services as indicated and specified.
- B. Section Includes:
 - 1. Pressed Steel Floor Boxes.
 - 2. Cast-iron Floor Boxes.
 - 3. Poke-thru Assemblies.
 - 4. Service Fittings and Accessories.

1.02 SUBMITTALS

- A. Product Data: Submit in accordance with Division 1. Describe each type of floor outlet and all accessory fittings.

1.03 REFERENCE STANDARDS

- A. Underwriters Laboratories (UL).
- B. National Electrical Manufacturers Association (NEMA) #250 - and OSI.

PART II - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Floor Box Outlets and Accessories:
 - 1. Walker.
 - 2. Thomas and Betts.
 - 3. Or equal.
- B. Surface fitting poke-thru floor outlets:
 - 1. Walker.
 - 2. Hubbell.
 - 3. Or equal.
- C. Flush fitting poke-thru floor outlets.

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1. Walker.
2. Raceway Components.
3. Or equal.

2.02 FLOOR BOX OUTLETS

- A. Concrete tight: Formed Steel, fully adjustable, installed at above grade floor levels.
- B. Watertight: Cast iron, fully adjustable, installed at grade level and below.
- C. Box Depth: Provide maximum depth box acceptable for floor construction. Provide shallow box only where approved by the University's Representative.
- D. Capacity: Provide multi-gang boxes where required for the services indicated on the drawings. Box sizes are not indicated on the drawings.
- E. Accessories: Provide all necessary accessories for a finished installation including gaskets, floor plates, covers with removable plate, device mounting plates, carpet flanges, services fittings and outlet devices.
- F. Finish: Finish of exposed accessories shall match the finish specified for service fitting.
- G. Device Outlets: Provide as indicated on the plans and as specified in Section 26 27 26 and the Sections which specify the system outlet indicated.

2.03 FLOOR OUTLET SERVICE FITTINGS

- A. Flush Floor Service Fittings: Provide flush service fittings unless otherwise indicated.
 1. Single Receptacle Power: Single flush 2-1/8" diameter screw type cover plate.
 2. Duplex Receptacle - Power: Duplex flush flip lid cover plate.
 3. Telephone/Communication: Two gang flush 2-1/8" x 1" diameter screw type cover plate.
 4. Finish: Coverplates, trim rings and carpet flanges shall be finished as follows:
 - a. Brass
- B. Above Floor Service Fittings: Provide above floor service fitting only where indicated by notes on the drawings or where approved by the University's Representative.
 1. Single or Duplex Receptacle: Die cast aluminum construction housing with front and back removable plates for the devices indicated. Provide locking baseplate to secure housing.
 2. Telephone/Communications: Same as before except provide faceplate opening to coordinate with the service indicated. Verify with University's Representative to assure coordination.

3. Finish: Housing and faceplates shall be finished satin aluminum.

2.04 POKE-THRU FLOOR OUTLETS (SURFACE FITTING)

- A. Poke thru floor outlets shall be used only where specifically noted on the drawings or where approved by the University's Representative.
- B. Poke thru service insert shall include the following feature.
 1. Capable of both power and voice/data cable and outlets in a single unit with separate raceways and barriers.
 2. Installation in a 2" to 3" maximum core drilled hole. Coordinate all slab penetrations with the structural design.
 3. Unit shall be a single length poke thru service insert to fit a floor thickness from 2-1/2" and greater.
 4. 4-hour fire rated insert of luminescent organic material to prevent passage of fire, smoke and toxic fumes shall meet State of California building code requirements.
 5. The poke-thru service insert shall be removable and reusable at another as well as the same location.
 6. The poke-thru service insert shall be large enough to pass an unoccupied 25-pair amphenol connector through the entire length of the poke-thru service when installing communications cable.
- C. Poke thru service fitting shall include the following requirements.
 1. No holes may be cut in the carpet on the floor for an installation of the poke-thru service fitting head. The service fitting head shall have a carpet saving feature which is UL listed for this application. The carpet should be cut in an "H" shape and the tabs are stored in a compartment in the base of the service fitting head. This must provide for the protection of the carpet tabs. In an abandoned mode, the carpet tabs must be able to be restored over the vacated location.
 2. When a location is to be abandoned, no metal plates are to be exposed.
 3. The poke-thru service shall be UL classified for full-range telephone placements and combinations with power, including 100-pair communications cable and power.
 4. All service fitting head accessories shall be interchangeable to meet the variations in the service fitting requirements as the floor plan or office layout changes.
 5. A specification grade 20-amp/125 volt, UL listed, duplex receptacle shall be included with the service fitting head package.
 6. The telephone or communications grommet shall be made of rubber or neoprene.

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7. The base of the service fitting head shall have a watertight gasket to prevent water from entering the poke-thru service insert. The base gasket shall be .125" thick, closed cell, sponge neoprene.
 8. The service fitting head shall have a clear anodized finish one mil thick over a .125" formed aluminum housing.
 9. The poke-thru service fitting head shall be compatible for installation on carpet or tile floors.
- D. Junction Box and Connection Requirements:
1. A 14 gauge, galvanized steel junction box, complete with ½" and ¾" knockouts with a single captive-screw fitting, shall be furnished with the poke-thru service.
 2. The junction box shall have a capacity for power and or telephone services.
- E. The entire assembly shall be UL listed and UL classified for 4 hour fire rating.

2.05 POKE-THRU FLOOR OUTLETS (FLUSH FITTING)

- A. Floor outlet shall be flush floor type designed for a single duplex receptacle with two individual openings for voice/data cabling in a single device. Unit shall be designed to fit through a 3" core drilled hole and maintain a 2-hour fire rating as listed and classified by UL
- B. Unit shall be provided with a 20-amp 125 volt duplex receptacle designed for specific use in the floor outlet and completely prewired to a j-box integral with the device. Assembly shall consist slideholder, finish flange, wired receptacle, insert retainer, conduit extension and j-box.
- C. Floor trim ring shall be Lexan textured painted with a two stage epoxy paint process. Color to be ebony to match receptacle.

PART III - EXECUTION

3.01 INSTALLATION - FLOOR OUTLETS

- A. Install floor outlets securely anchored into the building construction and level.
- B. Protect outlets during construction preventing entrance of foreign materials.
- C. Install and assemble outlets according to manufacturer's instructions.
- D. Install cast iron floor outlet boxes in all floors at and below grade, in damp or wet locations, or as indicated. In all other locations install pressed steel floor outlet boxes.
- E. Orient above-floor service fittings to face as indicated on the plans or as directed by the University. Install wiring devices complying with Section 26 27 26 – Devices and as shown on the plans.

3.02 INSTALLATION - POKE-THRU OUTLET

- A. Core drill holes for poke-thru assemblies, install according to manufacturer's instructions, and maintain UL fire rating of floor-ceiling assembly.
- B. Verify location of and avoid core drilling holes at reinforcing bars or through joists of pan-joint type floor construction. Bore holes evenly through the floor, do not break the bottom of the hole damaging the seal between the assembly and the concrete.
- C. Verify final locations of outlets with University's Representative from final furniture plans before core drilling holes.
- D. Core-drilled holes shall be spaced a minimum of two feet on center and not more than one hole per each 65 square feet of floor area in each building span. All slab penetrations shall be pre-approved by the structural engineer.

END OF SECTION 26 05 37

SECTION 26 05 53
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART I - GENERAL

1.01 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. Buried cable warnings.
 - 2. Electrical power, control and communication conductors.
 - 3. Operational instructions and warnings.
 - 4. Danger signs.
 - 5. Equipment/system identification signs.

1.02 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.

1.03 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 II - PRODUCTS

2.01 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
3. or equal

2.02 ELECTRICAL IDENTIFICATION MATERIALS

- A. Except as otherwise indicated, provide manufacturer's standard products of categories and types required for each application. Where more than single type is specified for an application, provide single selection for each application.
- B. Color-Coded Plastic Tape:
 1. Provide manufacturer's standard self-adhesive vinyl tape not less than 3 mils thick by 1-½" wide.
 - a. Colors: Unless otherwise indicated or required by governing regulations, provide orange tape.
- C. Underground-Type Plastic Line Marker:
 1. Manufacturer's standard permanent, bright-colored, continuous-printed plastic tape, intended for direct-burial service; not less than 6" wide x 4 mils thick. Provide tape with printing which most accurately indicates type of service of buried cable.
- D. 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.
- E. Plasticized Tags:
 1. Manufacturer's standard pre-printed or partially pre-printed accident-prevention and operational tags, of plasticized card stock with matte finish suitable for writing, approximately 3-¼" x 5-⅝", with brass grommets and wire fasteners, and with appropriate pre-printed wording including large-size primary wording, e.g., DANGER, CAUTION, DO NOT OPERATE.
- F. 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.

G. 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: 1/8", except as otherwise indicated.
3. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate substrate.

2.03 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 III - EXECUTION

3.01 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:

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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 Section 09 91 23 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. Underground Cable Identification:

1. During back-filling/top-soiling of each exterior underground electrical, signal or communication conduits, install continuous underground-type plastic line marker, located directly over buried line at 6" to 8" below finished grade. Where multiple small lines are buried in a common trench and do not exceed an overall width of 16", install a single line marker.
2. Install line marker for every buried conduit.

E. 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 panel boards, 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.

F. 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.

G. 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.

H. Equipment/System Identification:

1. Install engraved plastic-laminate sign on each major unit of electrical equipment in building; including central or master unit of each electrical system including communication/control/signal systems, unless unit is specified with its own self-explanatory identification or signal system. Except as otherwise indicated, provide single line of text, ½" high lettering, on 1-½" high sign (2" high where 2 lines are required), white lettering in black field. Provide text matching terminology and numbering of the contract documents and shop drawings. Provide signs for each unit of the following categories of electrical work:
 - a. Electrical cabinets and enclosures.
 - b. Access panel/doors to electrical facilities.
 - c. Transformers.
 - d. Fire alarm control panel, battery cabinets, voice alarm system cabinets, and transponders.
 - e. Automatic transfer switches.
2. Install signs at locations indicated or, where not otherwise indicated, at location for best convenience of viewing without interference with operation and maintenance of equipment. Secure to substrate with fasteners, except use adhesive where fasteners should not or cannot penetrate substrate. Identification of flush mounted cabinets and panel boards shall be on the inside of the device.
3. Panel boards, 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.

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- 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.

END OF SECTION 26 05 53

SECTION 26 05 54
ARC-FLASH LABELS

PART 1 - GENERAL

1.1 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 University by the Contractor.

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

3.1 GENERAL

- A. Arc-flash labels shall be provided according to NFPA 70E and section 26 05 53, Identification for Electrical Systems.

END OF SECTION 26 05 54

SECTION 26 05 73
SHORT CIRCUIT AND COORDINATION REPORT

PART I - GENERAL

1.01 DESCRIPTION

A. GENERAL:

1. This section specifies that the Contractor will adjust, set and test all adjustable short circuit and overcurrent protective devices. The Contractor will provide the University with a short circuit and coordination report which will contain the settings for the protective devices.

B. SCOPE:

1. The following equipment and associated devices will be included in the scope of the short circuit and coordination study:
 - a. 12.47 kV normal power switchgear.
 - b. 12.47 kV emergency power switchgear.
 - c. 20.8 kV – 12.47 kV transformers.
 - d. 12.47 – 4.16 kV transformers.
 - e. 12.47 – 0.48 kV transformers.
 - f. 4.16 kV switchgear, bus and motor starters.
 - g. 480-volt switchgear and switchboards.
 - h. 480-volt motor control centers.
 - i. 480-volt transfer switches.
 - j. All 12.47 kV cables.
 - k. All 4.16 kV cables.
 - l. All 480-volt feeder cables.
 - m. All 480-volt motors 50 HP and larger together with motor starters.
 - n. All medium voltage bus ducts.

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PART II - DELETED

PART III - EXECUTION

3.01 GENERAL

- A. The Contractor shall adjust and set all protective devices associated with the equipment specified in paragraph 26 05 73 – 1.01. Settings will be provided to the University by the Contractor.

3.02 TESTING

- A. Protective devices shall be tested in accordance with Section. 26 90 90.

END OF SECTION 26 05 73

SECTION 260942

DIGITAL LIGHTING CONTROL

PART 1 - GENERAL

1.01 SUMMARY

- A. Work included: Labor, materials, and equipment necessary to complete the installation required for the item specified under this Division, including but not limited to:
 - 1. Lighting control modules.
 - 2. Control stations.
 - 3. Occupancy sensors.
 - 4. Daylight sensors.
 - 5. Emergency bypass relays or transfer device.
 - 6. Network communication cabling.
 - 7. Startup and field quality control.
 - 8. Commissioning.
- B. Related Work: Consult all other Sections, determine the extent and character of related Work, and properly coordinate Work specified herein with that specified elsewhere to produce a complete installation.

1.02 REFERENCES

- A. Comply with the latest edition of the following applicable Specifications and standards except as otherwise indicated or specified:
 - 1. National Electrical Manufacturer Association (NEMA):
 - NEMA 250; Enclosures for Electrical Equipment.
 - NEMA ICS 1; Industrial Control and Systems.
 - NEMA ICS 4; Terminal Blocks and Industrial use.
 - NEMA ICS 6; Enclosures for Industrial Controls and Systems.
 - 2. Underwriters Laboratories, Inc. (UL):
 - UL 50; Enclosures for Electrical Equipment, Non-Environmental Considerations
 - UL 773A; Nonindustrial Photoelectric Switches for Lighting Control.
 - UL 916; Energy Management.
 - UL 924 Standard for emergency lighting and power equipment.
 - UL1008 Transfer switch equipment.

1.03 SYSTEM DESCRIPTION

- A. A standalone digital lighting control system that interconnects and lighting components such as occupancy and daylight sensors, control stations, etc. to control luminaires connected to the system. All components are locally connected and function independently of any central control software.
- B. Control of luminaries will come from distributed control modules capable of "ON/OFF" control and 0-10 volt dimming.
- C. The lighting control components shall be capable of adjusting their specific parameters such as dimming presets, time delays, etc. per the device type. Handheld or computer-based commissioning tools shall be available during startup to reduce the time required at startup and commissioning. These tools shall be available to the Owner after startup and commissioning.
- D. The control system is connected independent of electrical lighting circuits.
- E. The system shall utilize either hardwired or wireless components.

1.04 SUBMITTALS

- A. Submit in accordance with the requirements of Section 260010: Basic Electrical Requirements, the following items:
 - 1. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.
 - 2. Describe system operation, equipment and dimensions and indicate features of each component.
 - 3. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.
 - 4. Submit Manufacturer's installation instructions.
 - 5. Complete bill of materials listing all components.
 - 6. Warranty.

1.05 OPERATION AND MAINTENANCE MANUAL

- A. Supply operation and maintenance manuals in accordance with the requirements of Section 260500: Electrical General Requirements to include the following:
 - 1. Operation and maintenance manuals shall include the following:
 - a. A detailed explanation of the operation of the system.
 - b. Instructions for routine maintenance.
 - c. Pictorial parts list and part numbers.
 - 2. Telephone numbers for the authorized parts and service distributors.
 - 3. Final testing report.

1.06 QUALITY ASSURANCE

- A. All materials, equipment and parts comprising the units specified herein shall be new, unused, and currently under production.

- B. Only products and applications listed in this Section may be used on the Project unless otherwise submitted.

1.07 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery: Digital lighting control components shall not be delivered to the Project site until protected storage space is available. Storage outdoors covered by rainproof material is not acceptable. Equipment damaged during shipment shall be replaced and returned to Manufacturer at no cost to Owner.
- B. Storage: Store in a clean, dry, ventilated space free from temperature extremes. Maintain factory wrapping or provide a heavy canvas/plastic cover to protect units from dirt, water, construction debris and traffic. Provide heat where required to prevent condensation.
- C. Handling: Handle in accordance with Manufacturer's written instructions. Be careful to prevent internal component damage, breakage, denting and scoring. Damaged units shall not be installed. Replace damaged units and return equipment to Manufacturer.

1.08 WARRANTY

- A. Units and components offered under this Section shall be covered by a minimum 2-year parts and labor warranty for malfunctions resulting from defects in materials and workmanship. Warranty shall begin upon acceptance by the Owner.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Products furnished by the following Manufacturers shall be acceptable if in compliance with all features specified herein and indicated on the Drawings.
 - 1. Network addressable lighting control system:
 - a. Acuity "nLight".
- B. Substitutions: Under provisions of Section 260500: Basic Electrical Requirements.

2.02 GENERAL

- A. The lighting control system shall be standalone with no central control software. Lighting components shall tie together and communicate directly with each other as required for the device type.
- B. Control stations, occupancy sensors, and daylight sensors shall tie into dimming and relay modules to control luminaires.
- C. The control parameters shall be set within each device, either as dip switches or dials on the device itself or with handheld or computer-based commissioning tools. The parameters remain set until they are manually changed.
- D. Daylight sensors shall rationally change changes to light levels when daylight is available and shall maintain a steady light level when subjected to fluctuating ambient conditions.

- E. During an emergency condition (loss of normal power), the system shall not impede the emergency lighting to function properly, i.e. the control system shall control emergency lighting to turn on at full light output and lock out user controls.
- F. The control system shall allow occupancy sensor, when relaying a vacant status to either turn lights off or dim lights to a preset level.
- G. The control system components shall comply with the latest edition of the California Building Energy Efficiency Standards, California Building Code, Part 6 and be certified by The California Energy Commission.

2.03 LIGHTING CONTROL MODULES

A. General:

- 1. Lighting control modules provide an interface between the control system and luminaires. Modules take inputs from the system and convert the commands through the power and control wiring to the fixture providing "ON/OFF/DIMMING" functions.
- 2. Lighting control modules contain a 16 amp minimum rated relay(s) for "ON/OFF" control as well as a 0-10 volt dimming signal.
- 3. In the event of a power failure, control modules connected to luminaires shall default to the "on" state at full light output.

B. The following lighting control modules shall be available with the system, at a minimum:

- 1. Single □one 0-10 volt control module with a relay.
- 2. Multi-□one 0-10 volt control module with one relay per 0-10 volt zone ("Room Controller").

C. Mounting:

- 1. Single zone modules shall have a ½" nipple to mount directly to a ½" knockout on a junction box.
- 2. Multi-□one modules shall mount stand alone or onto a 4 square junction box.

2.04 CONTROL STATIONS

A. General:

- 1. The controllers are configurable wall mounted devices that provide local "ON/OFF/DIMMING" control to lighting zones.
- 2. Each device can be set-up and modified through the control systems software interface.
- 3. Control stations controlling life safety, critical, or equipment branch circuits shall be red in color.

B. Dimmer switch controller:

1. Software configurable dimmer switch that provides "ON/OFF" switching and the capability to dim.
 2. Dimming to be continuous over the full range of the driver or ballast it is controlling.
- C. Dimming scene controller:
1. Multi-button controller allowing the end user to recall zones or scenes for "ON/OFF/DIMMING" control.
 2. Scenes are made up of multiple zones, where each zone is dimmed to a specific light output.
 3. Scene configuration can be changed via control systems software.
 4. The scene controller shall also allow for a custom labeling feature that allows scene labels on the controller to be easily modified.
- D. Specifics:
1. Mounting:
 - a. Controllers utilize a standard single-gang device strap configuration for ease in mounting. Where multiple controllers are ganged together, they shall allow for a single multi-gang cover plate to be used.
 - b. Mounts to standard switch box or cut-in ring.
 2. Controllers shall tie to the system in one of the following ways:
 - a. Hardwired low voltage, wiring and connections per manufacturer's requirements.
 - b. Wireless with a 10-year minimum battery life. Mechanically triggered wireless switches shall not be allowed unless approved by The Owner.

2.05 OCCUPANCY SENSOR

- A. General:
1. Occupancy sensors shall automatically detect movement within a space, reporting the state of occupancy to the control modules for "ON/OFF/DIMMING" control of lighting zones and "ON/OFF" control of the controlled receptacle circuits within that space.
 2. All setpoints for the occupancy sensor shall be accessible on the device or through the commissioning tool.
 3. Sensors shall be capable of being linked together via hard wired connections to provide a larger coverage area.
 4. Provide enough occupancy sensors as required for complete area coverage they are installed in, regardless of how many sensors are shown on the Drawings.
- B. Specifics:
1. Sensor shall have a coverage of 1,000 square feet. Manufacturer to provide additional sensors if coverage is less than 1,000 square feet.

2. Sensors shall be infrared or dual technology or microphonic. Dual technology sensors shall be capable of disabling either infrared or ultrasonic sensing.

2.06 DAYLIGHT SENSOR

A. General:

1. Daylight sensors shall automatically measure the amount of ambient light within a space, reporting the state of occupancy to the control modules for "ON/OFF/DIMMING" control of lighting zones.
2. Setpoints for the sensors shall be adjusted directly on the device or through commissioning tool. The setpoints refer to the range at which electric lighting will dim in response to the amount of light the sensor detects.
3. Daylight sensors shall continuously monitor the ambient light level.
4. Interior daylight sensors shall operate on a "closed loop" protocol, measuring both daylight and electric light contributions.
5. Exterior daylight sensors shall operate on an "open loop" protocol, measuring only daylight contributions.

B. Specifics:

1. Sensor shall mount directly to any surface, no junction box required.
2. Integrated sensors on luminaires shall be installed at the lighting manufacturer's factory.
3. Sensors shall tie to the system in one of the following ways:
 - a. Hardwired low voltage, wiring and connections per manufacturer's requirements.
 - b. Wireless with a 10-year minimum battery life.
4. Exterior sensors shall be outdoor rated.

2.07 EMERGENCY BYPASS RELAYS

A. General:

1. System manufacturer shall provide emergency bypass relays as shown on the Drawings.
2. The bypass relay device shall take an uncontrolled normal sensing hot, uncontrolled emergency hot, and controlled normal circuit as inputs.
3. The device shall bypass the controlled normal hot and control signal at the loss of power from the normal sensing hot and allow the uncontrolled emergency hot to power the downstream luminaires.
4. The device shall be capable of accepting a 0-10 volt control signal and breaking if the downstream fixtures are 0-10 volt controlled.

B. Specifics:

1. Mounting: directly onto a junction box or integral to the luminaire.
2. UL924 rated for switched and dimmed loads.

2.08 DEVICE COMMUNICATION CABLING

A. General:

1. The device communication cabling integrates devices such as occupancy sensors, photocell sensors, control modules and control stations with each other to provide a complete standalone system.
2. The network communication cabling provides low-voltage power to all devices on the network, eliminating the need for external power supplies and power packs for devices such as occupancy sensors. Where a device requires 120 volt power it shall be noted on the submittal.
3. Cabling shall be topology free.
4. Cabling shall be plenum rated.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Contractor shall thoroughly examine Project site conditions for acceptance of low-voltage lighting control installation to verify conformance with Manufacturer and Specification tolerances. Do not commence with installation until all conditions are made satisfactory.

3.02 INSTALLATION

- A. Install the addressable lighting control system in accordance with the Manufacturer's written instructions, as indicated on the drawings and as specified herein.
- B. All interior luminaires shall be controlled via the control system unless otherwise noted on the plans. Refer to the drawing symbols list for the differentiation between networked luminaire devices and standalone devices.

3.03 OCCUPANCY SENSOR

- A. Occupancy sensors shall be placed in a location that provides maximum coverage and minimizes false positives such as being triggered through an open door.
- B. Refer to the architectural RCPs and locate sensors as shown or if not shown, locate in line with other ceiling devices while still maximizing area coverage.
- C. Where the coverage of a sensor is inadequate for the space it is being installed in, the manufacturer shall provide additional sensors for the contractor to install. The cost of these sensors and installation shall be included at the time of bid.

3.04 DAYLIGHT SENSORS

- A. Locate daylight sensors per the manufacturer's requirements in order to provide accurate electric and daylight light levels.
- B. Coordinate the final location of the sensor with other devices in the area.

3.05 CONTROL MODULES

- A. Install all control modules per the shop drawings and manufacturer's requirements. Ensure devices are in an accessible location. Avoid locations where the devices are visible to the public.

3.06 AUXILIARY DEVICES

- A. Where devices, not covered under these Division 26 specifications, are required to provide a complete lighting control system, furnish and install such devices per the manufacturer's instructions.

3.07 STARTUP AND FIELD QUALITY CONTROL

A. General:

- 1. All work related to the startup of the addressable lighting control system shall be by a factory-authorized agent of the Manufacturer of the system along with the assistance of the electrical contractor.
- 2. All programming, testing, trouble shooting, etc. shall be included in this contract.

B. Prefunctional testing:

1. Visual and mechanical inspection:

- a. Inspect for physical damage, defects alignment and fit.
- b. Perform mechanical operational tests in accordance with Manufacturer's instructions.
- c. Compare nameplate information and connections to Contract Documents.
- d. Check tightness of all control and power connections.
- e. Check that all covers, barriers, and doors are secure.

- 2. Contractor shall provide all necessary programming assistance to set up and program the lighting control parameters.

3. Electrical tests:

- a. The system shall be completely tested in accordance with operational parameters, tolerances, and Manufacturer's instructions. Any problem shall be documented and corrected.
- b. Test all control circuits and verify proper operation of all lighting circuits throughout the control system.
- c. Ensure the lighting zone controls match that of the Contract Documents.
- d. Provide a complete report listing every device, the date it was tested, the results and the date retested (if failure occurred during the previous test). The test report shall indicate that every device tested successfully.

- C. Contractor shall replace at no costs to the Owner all devices which are found defective or do not operate within factory specified tolerances.

- D. Contractor shall submit the testing final report for review prior to Project closeout and final acceptance by the Owner. Test report shall indicate test dates, devices tested, results, observation, deficiencies, and remedies. Test report shall be included in the operation and maintenance manuals.

3.08 COMMISSIONING

A. General:

1. Once startup of the system is complete and no defects to the system are detected the commissioning process shall begin; furthermore, it is acceptable to program the system per the commissioning requirements during the startup phase.
 2. All work related to the commissioning of the digital lighting controls shall be by the electrical contractor or by a factory-authorized agent of the Manufacturer of the system.
 3. At least three weeks prior to any commissioning verification, notify the Engineer so that arrangement can be made for witnessing test, if deemed necessary. All pretesting shall have been tested satisfactorily prior to the Engineer's witnessed test.
 - 4.
- B. Occupancy sensors:
1. All occupancy sensors shall have a sensitivity appropriate for the space. Contractor shall be responsible for testing the sensitivity of the sensor in the space and adjusting as needed.
 2. Where no direction is provided in a sequence of operation or by the owner set the occupancy sensor timeout to 15 minutes.
- C. Daylight sensors:
1. Where no direction is provided in a sequence of operation or by the owner, the daylight sensor setpoint to dim the electric light should be at 150 of the maximum electric light output.
- D. Scene controllers:
1. Where no scenes have been described in a sequence of operation or by the owner the contractor shall provide the following scenes as appropriate for the space:
 - a. Scene 1: All luminaires on at 100
 - b. Scene 2: Luminaires near screen displays off, all other luminaires on at 75
 - c. Scene 3: All indirect luminaires off, all direct luminaires on at 100
 - d. Scene 4: All direct luminaires off, all indirect luminaires on at 100
 - e. Scene 5: All luminaires off.
- E. Time schedules:
1. All time schedules required shall be done through an astronomical time clock integral to the devices and equipment. The building location and date shall be programmed to ensure proper time schedule functions.
 2. If no sequence of operations is provided program time schedules as follows:
 - a. Interior spaces: Per owner's direction, do not assume hours of operation.
 - b. Exterior spaces: on 30 minutes before sunset, and off 30 minutes after sunrise.

- F. Contractor shall be responsible for all acceptance testing requirements related to the lighting control system as outlined in the California Energy Code Title 24 Part 6.

3.09 TRAINING

- A. Factory authorized service representative shall conduct a 1-hour training session for Owner's Representatives upon completion and acceptance of system. Instruction shall include operation, programming, and maintenance of equipment.
- B. Contractor shall schedule training with a minimum of 7 days advanced notice.

END OF SECTION

**SECTION 26 27 26
WIRING DEVICES**

PART I - GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Receptacles
 - 2. Device Plates
 - 3. GFI Receptacles

1.02 SUBMITTALS

- A. Shop Drawings: Submit in accordance with Division 1.
- 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.

1.03 REFERENCE STANDARDS

- A. National Electrical Manufacturers Association.
 - 1. NEMA WD-1 - General Purpose Wiring Devices.
 - 2. NEMA WD-5 - Specific Purpose Wiring Devices.

PART II - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Leviton
- B. Pass and Seymour/Sierra
- C. or equal
 - No longer made.

2.02 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 unless specification grade is indicated as acceptable on drawings. 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

<u>Poles/ Wires</u>	<u>Volts</u>	<u>Amps</u>	<u>NEMA Configuration</u>	<u>Cat. No.</u>	<u>Use</u>
2P-3W	125	20	5-20R	8300	General Duplex
2P-3W	125	20	5-20R	7899-HG	General GFI Duplex
2P-3W	125	30	5-30R	5371	Equipment Single
2P-3W	250	20	6-20R	5461	Equipment Single
2P-3W	250	30	6-30R	5372	Equipment Single
2P-3W	125	20	5-20R	P& S. TR63-H	Tamper Resistant
2P-3W	125	20	5-20R	8300-IG	Isolated Ground

2.03 G.F.I. RECEPTACLES

- A. Type: 120 volt 20 ampere duplex non-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, roof tops, indoor wet locations, kitchens, locker rooms with associated showering facilities, garages, and at water fountains shall be ground fault interrupter type.

2.04 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. P&S #S3733-SS, or equal.
- D. Engraving:
 - 1. All device plates shall be engraved on the face with 1/8" 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.

PART III - EXECUTION

- A. 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.
- B. G.F.I. Receptacles:
1. Install ground fault receptacles at all receptacle locations indicated on the plan as G.F.I.
- C. 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.

3.02 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.

3.03 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

END OF SECTION 26 27 26

SECTION 26 28 13
FUSES – 600 VOLTS

PART I - GENERAL

1.01 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.

1.02 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.
 2. American National Standards Institute (ANSI):
 - 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

1.03 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract and Division 1 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.

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- 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 1.

PART II - PRODUCTS

2.01 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.

2.02 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.

2.03 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 percent spare capacity minimum.
 2. Finish: Gray baked enamel.
 3. Identification: Stencil legend "SPARE FUSES" in 1-½" (40 mm) letters on door.

PART III - EXECUTION

3.01 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.

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- 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.

3.02 IDENTIFICATION

- A. Install typewritten labels on the inside door of each fused device to indicate fuse replacement information.
- B. Provide written index of all required fuses and all spare fuses and include in University's Operating and Maintenance Manuals.

END OF SECTION 26 28 13

SECTION 26 28 16
ENCLOSED DISCONNECT SWITCHES

PART I - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Disconnect Switches.
 - 2. Enclosures.

1.02 SUBMITTALS

- A. Shop Drawings: Submit in accordance with Division 1, including the following:
 - 1. Outline Drawing with Dimensions.
 - 2. Equipment Ratings.
 - a. Voltage.
 - b. Capacity.
 - c. Horsepower.
 - d. Short Circuit Withstand Rating.

1.03 REFERENCE STANDARDS

- A. National Electrical Manufacturers Association (NEMA).
- B. Underwriters Laboratories (UL).

PART II - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. General Electric.
- B. Square D.
- C. Or Equal

2.02 DISCONNECT SWITCHES

- A. Switches shall be heavy duty type, 250-volt or 600-volt and 2 pole or 3 pole as required. Switches shall be visible blade type with quick-make, quick-break operating mechanism, full cover control circuit interlock and means for padlocking.

- B. Switches shall be fused or non-fused as required and shall be properly sized for the load. All switches shall be horsepower rated and shall always be equal to or exceed the horsepower rating of the motor being protected. Where fuseable disconnects are used 3 spare fuses must be provided to the University.
- C. Switches shall be enclosed in a NEMA 1 enclosure for interior, or a NEMA 3R enclosure for exterior. Indoor switches, in wet locations, shall be NEMA 4X.
- D. All switches using current limiting fuses shall have rejection type fuse clips.
- E. All steel surfaces shall be chemically cleaned and treated to provide a bond between paint and metal surfaces to help prevent the entrance of moisture and formation of rust under the paint film. The switch enclosure shall be finished in ASA-#61 light gray.

PART III - EXECUTION

3.01 INSTALLATION

- A. Install disconnects where indicated on drawings and required by governing code.
- B. Mount disconnect switches securely to building structure or equipment. Where switches are mounted to concrete or block walls, concrete anchors will be used. Switches mounted to gypsum board walls shall be secured by toggle bolts. Reinforcing channels shall be used on gypsum board walls or equipment for mounting switches.
- C. Switches shall not be supported by conduit.
- D. Comply with all applicable seismic requirements.
- E. Locate disconnect switch within sight of motor as required by the CEC.

END OF SECTION 26 28 16

**SECTION 26 51 13
LIGHTING FIXTURES**

PART I - GENERAL

1.01 SUMMARY

- A. Section Includes
 - 1. Light Fixtures
 - 2. LEDs
 - 3. Egress and Exit Signs
 - 4. Mounting and Installation Hardware
 - 5. Fixture Allowances
 - 6. 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 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 not 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, and mounting hardware in shop drawing submittal. Incomplete submittal will be returned 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 samples.
 - b. Samples will be held by the University's Representative until completion of the approval process and then returned.
- E. Submit quantity invoices for all lamps which qualify for energy rebates in accordance with Section 01700 (Contract closeout).

1.03 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Division 1.
- B. Accurately record actual locations of each luminaire.

1.04 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Division 1.
- 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 Underwriter's 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 Manufacturer's Association (NEMA).
- D. Illuminating Engineering Society of North America (IESNA).
- E. National Fire Protection Agency (NFPA).

1.08 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 designed to distribute the light.

1.09 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 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.

1.10 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.

1.11 WARRANTY

- A. Exit Signs Utilizing LED 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 shall apply for the remaining six years.

PART 2 – PRODUCTS

2.01 LIGHT FIXTURES – GENERAL

- 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, ballast 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 fixtures designed and/or gasketed to prevent light leaks from around lenses, trims and/or frames.
- F. Provide lenses that are 100% virgin acrylic, .156" thick nominal, Pattern 19, unless noted otherwise in the Light Fixture Schedule.
- G. Provide downlights with clear alzak cones and self-flange trims unless noted otherwise on the Drawings.
- H. Provide parabolic aluminum louvers or cones designed to eliminate or provide very low iridescence when used with tri-phosphor lamps.
- I. Where threaded fasteners are used for latching frames provide fasteners designed to be captive into the frames.
- J. 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 Section 09510. Refer to architectural reflected ceiling plans and details. Coordinate with ceiling type provided by the Designer.
- K. Finish ferrous mounting hardware and accessories to prevent corrosion and discoloration to adjacent materials.
- L. 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.
- M. 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 natural gray unless otherwise specified in the Light Fixture Schedule.

3. Finish of regress door shall be matte black enamel paint in color as selected by the Architect.
- N. For adjustable fixtures, provide positive locking devices to fix 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 CEC Article 300-22.
- P. 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: AAA 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 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 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 than 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. Solar Heat Resistance (SHR)

2.04 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.
 7. Drivers must comply with FCC 47 CFR Part 15 non-consumer RFI/EMI Standards.
 8. Drivers must be Reduction of Hazardous Substances (RoHS) compliant.

9. Drivers must comply with requirements in Section 2.5 B Controls.

2.05 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.

2.06 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.

2.07 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 controls as shown on Drawings.

2.08 EXIT LIGHTS/EXIT SIGNS

- A. Acceptable manufacturer:
 - 1. As specified in Light Fixture Schedule.
- B. Provide cast aluminum stencil face Exit Signs with fully concealed chevron type directional arrow knockouts and universal mount canopy unless otherwise indicated 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.

2.09 GENERAL REQUIREMENTS FOR POLES AND SUPPORT COMPONENTS

- A. Structural Characteristics: Comply with AASHTO LTS-5-E
 - 1. Wind-Load Strength of Poles: Adequate at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of speed indicated in "Structural Analysis Criteria for Pole Selection" Article.
 - 2. Strength Analysis: For each pole, multiply the actual equivalent projected area of luminaires and brackets by a factor of 1.1 to obtain the equivalent projected area to be used in pole selection strength analysis.
- B. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts unless otherwise indicated.
- C. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components:
 - 1. Materials: Shall not cause galvanic action at contact pints.
 - 2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.
 - 3. Anchor-Bolt Template: Plywood or steel.

- D. Handhole: Oval-shaped with minimum clear opening of 2-1/2 by 5 inches (65 by 130 mm), with cover secured by stainless-steel captive screws. Provide on all except wood poles.
- E. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Concrete reinforcement, and framework are specified in Division 03 Section "Cast-in-Place Concrete".
- F. Power-Installed Screw Foundations: Factory fabricated by pole manufacturer, with structural steel complying with ASTM A 36/A 36M and hot dipped galvanized according to ASTM A 123/A 123M; and with top-plate and mounting bolts to match pole base flange and strength required to support pole, luminaire, and accessories.
- G. Breakaway Supports: Frangible breakaway supports, tested by an independent testing agency acceptable to authorities having jurisdiction, according to AASHTO LTS-4-M.
- H. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied as stated in AASHTO LTS-5-E.
- I. Live Load: Single load of 500 lb (2224 N), distributed as stated in AASHTO LTS-5-E.
- J. Ice Load: Load of 3 lb/sq. ft. (145 Pa), applied as stated in AASHTO LT5-5-E Ice Load Map.
- K. Wind Load: Pressure of wind on pole and luminaire and banners and banner arms, calculated as applied and stated in AASHTO LT5-5-E.
 - 1. Basic wind speed for calculating wind load for poles 50 feet (15 m) high or less is 100 mph (45 m/s).
 - a. Wind Importance Factor: 1.0. Minimum design life: 25 years
Velocity Conversion factors are 0.93 non hurricane location.

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 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. 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 luminaires 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-resistive 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.
- Y. Replace all burned out or inoperative lamps at the end of the construction prior to Owner occupancy.
- BB. 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 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 (1200 mm), 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 insure 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 Architect's 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 connection 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 photometric 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 to standards.

3.06 DEMONSTRATION

- A. Provide a minimum of two hours demonstration of luminaire operation.

END OF SECTION
26 51 13

UC DAVIS MEDICAL CENTER
DT1 #1745B CATH LAB REPLACE X-RAY EQUIPMENT
PROJECT NO. 9557230

SECTION 26 90 90
ELECTRICAL EQUIPMENT ACCEPTANCE TESTING

PART I - GENERAL

1.01 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.

1.02 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 1 of this specification.

1.03 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
 - 2. American Society for Testing and Materials – ASTM

3. Association of Edison Illuminating Companies – AEIC
 4. Institute of Electrical and Electronics Engineers – IEEE
 5. Insulated Power Cable Engineers Association – IPCEA
 6. International Electrical Testing Association – NETA Acceptance Testing Specifications
 7. California Electrical Code – CEC
 8. National Electrical Manufacturers Association – NEMA
 9. National Fire Protection Association – NFPA
 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.

1.04 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.

1.05 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.

1.06 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.

1.07 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

2.01 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

3.01 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. Molded Case Circuit Breakers – C
2. Fire Alarm System – M
3. Grounding System – C
4. Cables, Low Voltage, 600 Volts Maximum – C
5. Lighting Control System – C
6. Security Systems – M

3.02 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.

3.03 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.

3.04 GROUNDING SYSTEM

- A. Visual and Mechanical Inspection:
1. Inspect wiring system outlet and junction boxes for proper grounding. Green grounding conductor shall be connected to outlet and junction boxes. Inspect a minimum of 5 of project boxes.
 2. Verify connections of grounds for the secondary of separately derived grounding systems, i.e. at dry type transformers. Note type of connection, i.e. mechanical or exothermic.
 3. Verify proper connection to all components of building service entrance grounding system. Note all system components which are interconnected and type of connection either mechanical or exothermic. Note depth of driven ground rods.
- B. Electrical Tests (Small Systems):
1. Perform ground-impedance measurements utilizing the fall-of-potential method per ANSI/IEEE Standard 81 "IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System". Instrumentation utilized shall be specifically designed for ground impedance testing. Provide sufficient spacing so that plotted curves flatten in the 62 area of the distance between the item under test and the current electrode.
- C. Equipment Grounds:

1. Utilize two-point method of IEEE Std. 81. Measure between equipment ground being tested and known low-impedance grounding electrode or system.

D. Electrical Tests (Large Systems):

1. When sufficient spacing of electrodes described above is impractical, perform ground-impedance measurements utilizing either the intersecting curves method or the slope method. (Ref. Nos. 40 and 41 in IEEE Std. 81.)

E. Test Values:

1. The main ground electrode system impedance-to-ground should be no greater than five (5) ohms. Equipment grounds, depending on size and length of grounding conductor, should be only fractionally higher than system ground.

3.05 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 indicate 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 megohmmeter, 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.

3.06 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 an 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.

END OF SECTION 26 90 90

SECTION 27 05 00
COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes, but is not necessarily limited to, common standards and procedures for the Communications Work.
- B. This Section outlines areas of responsibility between Owner, Architect, and Contractor.
- C. Owner will assist with a collaborative process to determine the most cost effective and efficient means to reach the common goal of providing communications within the facility for the project, including assessing user needs and assessing required pathways. The Owner is available upon request to assist at no additional cost to the project. It is incumbent upon the construction team management to approach and engage the Owner at the appropriate times for collaboration.
- D. As part of the project, the construction team must design, engineer, and provide complete, all means of support, suspension, attachment, fastening, bracing, and restraint (hereinafter "support") of the Communications Systems; and provide engineering of such support by parties licensed to perform work of this type in the project jurisdiction.

1.2 ITEMS PROVIDED BY OWNER

- A. Registered Communications Distribution Designer (RCDD) support services
- B. IT project management
- C. Submittal approvals
- D. Network equipment
- E. 802.11 Wireless Access Point hardware
 - 1. Installation by construction team when wireless access point mounting requires seismic support or a construction activity such as screwing, drilling, or welding
 - 2. Owner will provide 802.11 design services
- F. Rack and Stack
- G. Plug Pack Distribution (Pre-terminated switch port cabling provided and installed by the Owner)
- H. Patch Cords and Patching
- I. IT UPS System (installation by construction team)
- J. PDU Power distribution Equipment
- K. VOIP Router, Voice Gateway, VOIP equipment

- L. Camera NVR/Server
- M. Overhead Paging Amplifier
- N. TV Distribution Amplifier
- O. Closet Cleaning postproduction

1.3 ITEMS PROVIDED BY CONSTRUCTION TEAM

- A. Building Drawings and Floor Plans
- B. Site Plans
- C. Furniture Plans
- D. As-Built Drawing Submittals
 - 1. Cabling Schedule
- E. Attachments to structure
- F. In wall cabling
- G. In wall cabling supports
- H. Wireless Access point installation
- I. Cabling test results
- J. Patch Panels
- K. Horizontal Wire Managers
- L. Vertical Wire Managers (installation by construction team)
- M. Racks for mounting cabling and equipment (installation by construction team).
- N. Horizontal cable, jacks, faceplates, surface mount boxes, cable trays, termination hardware, and all materials needed for a complete horizontal cabling plant as defined in the Section and associated Sections and the construction documents not otherwise listed for provision by the Owner.
- O. Construction Clean Closet Cleaning

1.4 REFERENCES AND STANDARDS

- A. Reference to codes, standards, specifications and recommendations of technical societies, trade organizations and governmental agencies shall mean that latest edition of such publications adopted and published prior to submittal of the bid. Consider such codes or standards a part of this Specification as though fully repeated herein.
 - 1. UC Davis Health Telecommunications Standards

2. American National Standards Institute (ANSI)
 3. Telecommunications Industry Association (TIA)
 4. Building Industry Consulting Services International (BICSI)
 5. American Society for Testing and Materials (ASTM)
 6. Institute of Electrical and Electronic Engineers (IEEE)
 7. National Electrical Manufacturers Association (NEMA)
 8. Underwriters Laboratories, Inc. (UL)
 9. Local Authorities Having Jurisdiction (AHJ)
- B. Codes: Perform Work executed under this Section in accordance with applicable requirements of the latest edition of governing codes, rules and regulations including but not limited to the following minimum standards, whether statutory or not:
1. United States Department of Labor (DOL) Regulations (Standards - 29 CFR)
 2. Part 1910, "Occupational Safety and Health Standards"
 3. California Code of Regulations (CCR) Title 24, California Building Standards Code Part 2, Basic Building Regulations and Part 3, California Electrical Code (CEC).
 4. 2016 California Building Code (CBC).
 5. 2016 California Fire Code (CFC).
 6. 2016 California Mechanical Code (CMC).
 7. National, State and any other binding building and fire codes.
 8. FCC Regulations:
 - a. Part 15 – Radio Frequency Devices & Radiation Limits
 - b. Part 68 – Connection of Terminal Equipment to the Telephone Network
 9. Underwriter's Laboratories (UL): Applicable listing and ratings, including but not limited to the following standards:
 - a. UL 444: Communications Cables
 - b. UL 497: Protectors for Paired-Conductor Communication Circuits.
 - c. UL 1651: Optical Fiber Cable
 - d. UL 1690: Data-Processing Cable
 - e. UL 1963: Communications-Circuit Accessories
 - f. UL 2024A: Optical Fiber Cable Routing Assemblies.
 10. ANSI/TIA/EIA-568-D Commercial Building Telecommunications Cabling Standard.
 11. ANSI/TIA/EIA-569-E Commercial Building Standard for Telecommunications Pathways and Spaces.
 12. ANSI/TIA/EIA-598-B Optical Fiber Cable Color Coding.
 13. ANSI/TIA/EIA-606-C Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.
 14. ANSI/J-STD-607-D Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.
 15. ANSI/TIA/EIA-758 Customer-Owner Outside Plant Telecommunications Cabling Standard.
 - a. TIA/EIA-758-1 Addendum No. 1

16. EIA testing standards.
17. Insulated Cable Engineers Association (ICEA):
 - a. ANSI/ICEA S-80-576-2002 Category 1 & 2 Individually Unshielded Twisted Pair Indoor Cables for Use in Communications Wiring Systems
 - b. ANSI/ICEA S-83-596-2016 Fiber Optic Premises Distribution Cable
 - c. ANSI/ICEA S-87-640-2016 Fiber Optic Outside Plant Communications Cable
 - d. ANSI/ICEA S-90-661-2012 Category 3, 5, & 5e Individually Unshielded Twisted Pair Indoor Cable for Use In General Purpose and LAN Communication Wiring Systems
 - e. ICEA S-104-696-2019 Standard for Indoor-Outdoor Optical Cable
18. Telecommunications Distribution Methods Manual (TDMM)

1.5 ABBREVIATIONS

- A. ADA Americans with Disabilities Act
- B. AFC Above Finished Ceiling
- C. AFF Above the Finished Floor
- D. BDF Building Distribution Frame – See Telecommunications Room (TR)
- E. BLDG Building
- F. CAT Category (Related to network cable types)
- G. DIV Division
- H. (E) Existing
- I. ER IT Equipment Room – See Telecommunications Room (TR)
- J. GE Grounding Equalizer – Part of the Telecom Grounding System
- K. HR Homerun
- L. ID Inside Diameter
- M. IDF Intermediate Distribution Frame – See Telecommunications Room (TR)
- N. IT UC Davis Health IT Department (also UC, UCDH, UCD IT, IT Facilities)
- O. LAN Local Area Network
- P. MAX Maximum
- Q. NIC Not in Contract
- R. OD Outside Diameter
- S. TBB Telecom Bonding Backbone – Part of the Telecom Grounding System

- T. TGB Telecommunications Ground Busbar
- U. TMGB Telecommunications Main Ground Busbar
- V. TR Telecommunications Room, TR may also be used interchangeably with ER, IDF, MDF, or Communications Room
- W. TYP Typical
- X. UCD UC Davis Health IT Department (also UC, UCDH, UCD IT, IT Facilities)
- Y. UFE University Furnished Equipment
- Z. UON Unless Otherwise Noted

1.6 DEFINITIONS

- A. Telecommunications Room (TR) – An enclosed space for housing telecommunications equipment, cable, terminations, and cross-connects. The room is the recognized cross-connect between the backbone cable and the horizontal cabling.
- B. Intermediate Distribution Frame (IDF) – See Telecommunications Room (TR)
- C. Entrance Facility (EF) (Telecommunications) – An entrance to the building for both private and public network service cables (including antennae) including the entrance point at the building wall and continuing to the entrance room or space.
- D. Pathway – A physical infrastructure utilized for the placement and routing of telecommunications cable.
- E. Infection Control – Clinical Environment Infection Control or ICRA
- F. “Cabling”: A combination of cables, wire, cords, and connecting hardware [e.g., cables, conductor terminations, connectors, outlets, patch panels, blocks, and labeling].
- G. “Identifier”: A unique code assigned to an element of the telecommunications infrastructure that links it to its corresponding record.

1.7 QUALITY ASSURANCE

- A. Contractor Firm Qualifications:
 - 1. All work for the Communications (low voltage) Infrastructure installation shall be self-performed by the Communications Contractor; subcontractors shall not be allowed under the Communications Contractor.
- B. Communications Contractor shall:
 - 1. Be a Panduit Corp. PCI (Panduit Certified Installer) Design and Installation Contractor or approved equal.
 - 2. Be a firm which is regularly and professionally engaged in the installation and testing of the specified communications equipment and infrastructure.

3. Be licensed to install low voltage electronic cabling systems in the State of California where applicable (C7 License).
- C. Communications Contractor shall demonstrate experience in providing successful installation of data infrastructure systems:
1. Submit documentation for a minimum of three and a maximum of five successful low voltage communications infrastructure system installation projects completed within the past three years.
- D. Contractor Key Personnel Qualifications:
1. Provide key personnel who are regularly and professionally engaged in the business of the application, installation and testing of the specified low voltage communications systems, equipment and infrastructure. There may be one key person or more key persons proposed for this project depending upon how many of the key roles each has successfully provided.
 2. Each of the key personnel shall demonstrate experience in providing successful low voltage communications systems, equipment and infrastructure within the past three years.
- E. A Registered Communications Distribution Designer (RCDD) shall be employed by the Design Builder and directly engaged in the project for all Communications Infrastructure design and installation efforts.
1. The RCDD shall be a direct employee of the Communications Contractor, within the Design Build team structure.
 2. The RCDD shall be required to have oversight and supervision of the entire Communications Infrastructure installation process and quality control.
 3. The RCDD shall be the Design Builder's Designer of Record for the Communications Infrastructure scope of work.
 4. RCDD direct responsibilities shall include but may not be limited to: Thorough coordination with Owner regarding all design and installation efforts related to the project. A Pre-construction coordination meeting and site inspection with Owner prior to beginning any work. Oversight of Communications installation efforts, development of shop drawings and assembly of product data submittals. Quality control review and stamping of finalized Communications as-built drawings for submittal to Owner. Quality control review of Communications systems installation throughout the entire construction phase, to ensure all work is performed in compliance with approved construction drawings.
- F. Critical on-site quality control installation reviews to be conducted in conjunction with Owner technical staff shall include but may not be limited to:
1. Validation of design to conform with Infection Control guidelines required as it applies with the type of structure and services to be provided in each specific area.
 2. Verifying proper installation of all Communications cable tray, backbone conduits, device back boxes, conduit infrastructure and cabling pathways. Site inspection and sign-off must be performed prior to concealing conduit infrastructure and prior to the installation of any low-volt cabling.
 3. Verifying proper installation of all Communications cabling. Site inspection and sign-off must be performed prior to closing-up associated accessible ceilings.
 4. Verifying the layout and installation of all equipment and cabling within the Telecom Rooms, throughout the duration of the construction phase.

- G. Supervisors and installers assigned to the installation of this system or any of its components shall be Building Industry Consulting Services International (BICSI) Registered cabling Installers, Technician Level. Submit documentation of current BICSI certification for each of the key personnel. Submit documentation for a minimum of three and a maximum of five successful cabling system installations for each of the key personnel in an environment resembling that which is being bid upon.
1. In lieu of BICSI certification, supervisors and installers assigned to the installation of this system or any of its components shall have a minimum of three years' experience in the installation of the specified copper and fiber optic cable and components. The personnel on site performing work pertaining to this job shall be certified on the system being installed. They shall have factory or factory approved certification from each equipment manufacturer indicating that they are qualified to install and test the provided products.
 2. Submit documentation for a minimum of three and a maximum of five successful cabling system installations for each of the key personnel in an environment resembling that which is being bid upon. Documentation for each key person shall include at least two successful system installations provided that are equivalent in system size and in construction complexity to the telecommunications system proposed for this project. Include specific experience in installing and testing telecommunications systems and provide the names and locations of at least two project installations successfully completed using optical fiber and copper telecommunications cabling systems.
 3. All of the existing telecommunications system installations offered by the key persons as successful experience shall have been in successful full-time service for at least 18 months prior to the issuance date for this project.
 4. Provide the name and role of the key person, the title, location, and completed installation date of the referenced project, the referenced project Owner point of contact information including name, organization, title, and telephone number, and generally, the referenced project description including system size and construction complexity.
- H. Indicate that all key persons are currently employed by the Communications Contractor or have a commitment to the Communications Contractor to work on this project. All key persons shall be employed by the Communications Contractor at the date of issuance of this project, or if not, have a commitment to the Communications Contractor to work on this project by the date that the bid was due to the Owner's Representative.
1. Note that only the key personnel approved by the Owner's Representative in the successful proposal shall perform work on this project's low voltage systems, equipment, and infrastructure. Key personnel shall function in the same roles in this contract, as they functioned in the offered successful experience. Any substitutions for the Communications Contractor's key personnel require approval from the Owner's Representative.
- I. Designated Supervisor: Designate which key person will serve as a designated supervisor for the project. This supervisor shall be present and responsible for the project site during all phases of installation and testing of the Work in this Section. This supervisor shall be the same individual through the execution of the Work unless illness, loss of personnel, or other circumstances reasonably beyond the control of the Contractor intervene.
- J. Submit documentation for a minimum of three and a maximum of five successful low voltage systems, equipment, and infrastructure installations for each of the key personnel.
- K. Documentation for each key person shall include at least two successful system installations provided that are equivalent in system size and in construction complexity to the low voltage communications systems, equipment and infrastructure proposed for this project. Include specific experience in installing and testing communications systems and provide the names and

locations of at least two project installations successfully completed using systems and equipment substantially similar to those specified for this project.

- L. All the existing low voltage communications systems, equipment and infrastructure installations offered by the key persons as successful experience shall have been in successful full-time service for at least 18 months prior to the issuance date for this project.
- M. Provide the name and role of the key person, the title, location, and completed installation date of the referenced project, the referenced project Owner point of contact information including name, organization, title, and telephone number, and generally, the referenced project description including system size and construction complexity.

1.8 SUBMITTALS

- A. All Submittals shall be provided electronically in PDF format. All Drawing Submittals shall be provided in PDF and AutoCAD (latest version) DWG format.
- B. Submittals shall be organized in a coordinated package complete with all information specified herein. Incomplete or uncoordinated submittals will be returned with no review action.
- C. Contractor shall submit the following items:
 - 1. Contractor Key Personnel and Certifications
 - 2. Complete Bill of Materials (BOM) List
 - 3. Manufacturer Product Data Sheets, as defined below
 - 4. Shop Drawings, as defined below
 - 5. Proposed Installation Schedule
 - 6. Cabling Certification Test Plan and proposed test equipment
- D. Manufacturer Product Data Submittals shall include:
 - 1. Submit product data sheets for all equipment being provided.
 - 2. Collate in sequence by Section Number, and clearly mark proposed product on data sheet. Include Safety Data Sheet, where applicable.
 - 3. Clearly identify any proposed product substitutions or known deviations.
- E. Precede each submittal book with a summary TOC. per example schedule below:
 - 1. Specification Section
 - 2. Drawing Reference
 - 3. Manufacturers Model No.
- F. The following is a general summary list of Submittal items required to be delivered at 30-day burn-in period.
 - 1. As part of project close-out activities, Contractor shall submit Record Documents for review and approval by the Owner.
 - 2. All Record Documents shall be provided electronically in PDF format. All Record Document Drawings shall be provided in PDF and AutoCAD (latest version) DWG format.

1.9 CLOSEOUT SUBMITTALS

- A. Contractor shall submit the following items:
 - 1. Record As-Built Shop Drawings indicating the final, 'as-built' condition of all associated equipment, infrastructure, and work.
- B. Shop Drawing Submittals shall include:
 - 1. Drawing index/symbol/schedule sheet.
 - 2. Clearly indicate all new work versus existing work.
 - 3. Site Plans, Floor Plans, and Reflected Ceiling (work 7' AFF+) Plans
 - 4. Drawings shall be developed in AutoCAD .DWG format, utilizing most current architectural backgrounds available for the project.
 - 5. All drawings shall be properly scaled.
 - 6. Indicate all device locations and types. Include addressing for all network outlets (as
 - 7. Indicate all cabling routes, types and quantities.
 - 8. Indicate all conduit routing, quantities, sizes, and wire fill. Indicate basket tray and J-hook routes.
 - 9. Indicate fire stopping requirements for all penetrations.
 - 10. Indicate 'cable bundle groups' no larger than:
 - a. CAT5e – 52
 - b. CAT6 – 64
 - c. CAT6A – 74
 - 11. When bundling low voltage cabling together the lowest common denominator determines the largest cable group allowed unless the cable is LP listed.
- C. Riser Diagrams indicating:
 - 1. Backbone cabling and termination locations. Associated cabling pathways, sizes and cable fill. Telecommunications Grounding System.
- D. Enlarged Room Plans and Elevations indicating:
- E. Provide dimensioned drawings for all telecommunications rooms. Complete, dimensioned rack and wall elevations of all equipment. Consideration must be given to equipment heights within. Plywood backboards and grounding equipment.
- F. Racks, cabinets, cable tray, ladder rack, wire management. Termination equipment for all copper and fiber cabling. Conduit and cable entrance points and fire stopping. Electrical panels, power circuits and HVAC provisions.
- G. Ensure coordinated arrangement of equipment with other trades. Typical Device Installation Details indicating: J-hooks, conduit, cable tray, and associated support systems. Network outlet faceplate layout and wiring terminations. Device back box and conduit rough-in requirements.
- H. Details of other associated devices and equipment.

- I. The shop drawing package must be stamped and signed by a Registered Communications Distribution Designer (RCDD). Signatures by a Professional Engineer (PE) licensed in the project jurisdiction for work of this type as required by the AHJ.
- J. Cable Certification Test Results. Submit electronically and include associated software license as applicable.
- K. Completed punch list reports.
- L. Manufacturer Operation and Maintenance (O&M) Manuals.
- M. Warranty information.
- N. Keys and any portable equipment.

1.10 WARRANTY SERVICE

- A. Closeout Submittals, Warranties and Guarantees, provide the following.
 - 1. Response Time: Provide a qualified technician familiar with the work at the project site within four hours after receipt of a notice of malfunction. Provide the Owner's Representative with telephone number attended 10 hours a day, five days a week, to be called in the event of a malfunction.
 - 2. Provide all Warranties as defined in each Communication Systems Section.
- B. PanGen Structured Cabling Solutions System Warranty
 - 1. Contractor shall provide a Panduit Certification Plus System Warranty on all installed copper and fiber permanent links. Such warranty shall provide a complete system warranty to guarantee high end-to-end performance for all applications designed to operate over the class of cabling installed. The guarantee shall include all connectivity components and cable within the permanent link and cover the system for duration of 25 years.

PART 2 - MATERIALS

2.1 COMMUNICATIONS SYSTEMS PRODUCTS SUMMARY

- A. The following is a general summary list of Communications Systems equipment, components, and cabling required for the project. This is not intended to be a comprehensive list of materials. See additional Sections for complete materials requirements.
- B. Racks: Cooper B-line SB85219096FB (seismic) I SB556096XUFB. Racks will be eight foot for new builds and remodels where space is available. Seven-foot racks will be used as an alternate where space is not available for taller racks. Wire Managers: Panduit PEV Series full height vertical cable manager.
- C. Wire Managers: Panduit PE2V Series full height vertical cable manager.
 - 1. 10" Wide Front/Back unless otherwise noted on plans
 - 2. 96 inch or 84 inch sized to match the racks being installed.
- D. Telecommunications Ground Bar (TGB) CPI_Mfg.Part:40153-012

- E. Data Patch Panels: Panduit CP48WSBLY
- F. Fiber Terminations: LC
- G. Modular Jack CAT6A
 - 1. Panduit Mini-Com CJ6X88TGV
 - 2. Colored Icons as needed per UC service designation
 - 3. Icons are Panduit PAN_CID(XX) (gray for cables in ceiling)
- H. Copper cabling, Category 6A (Data)
 - 1. High Speed, TIA Category 6A cabling, Plenum Rated
 - 2. General Cable GenSpeed 6A Part No. 7141877 Purple
 - 3. General Cable GenSpeed 6A Part No. 7151855 Purple
 - a. Use of the improved Genspeed cable is dependent on availability. Do not default to this cable if lead times are excessive.
- I. Copper cabling, Category 6A Shielded (Overhead Paging)
 - 1. High Speed, TIA Category 6A Shielded cabling, Plenum Rated
 - 2. General cable GenSpeed 6A Part No. 7131789
- J. Telecommunications Outlets (Workstation side)
 - 1. Modular Furniture Surface Mount Box, Black
 - 2. Panduit CBXQxBL-A Where x =number of ports
 - 3. Modular Surface Mount Box Attachment System - Mini-Com CBM-X magnetic
 - 4. Modular Surface Mount Box Blank Insert - Panduit CMB(BL)
- K. Faceplate (Workstation side)
 - 1. Panduit Mini-Com Stainless Steel Faceplates Single Gang CFP {2,4,6} SY or Double Gang CFP {4,8,10} S-2GY
 - 2. Faceplate Blank Insert – Panduit CMB(WH)

PART 3 - EXECUTION

3.1 TELECOMMUNICATIONS SPACES

- A. Telecom Room (TR) minimum size 10' x 14'.
- B. UC Davis Health Telecommunications Standards do not include provisions for AV, unless otherwise indicated in the Design Criteria for the project. IT will be cooperative in assessing some parameters as they interact with IT support systems.
- C. Telecommunication Spaces are to use EZ-Path Fire-Rated Pathways systems for cabling access.
- D. Provide 36" of working clearance in front and back of racks and electronic equipment.

- E. A positive pressure type of HVAC system using hot and cold aisles.
- F. Walls shall be covered with fire-resistant treated plywood, and all surfaces sealed to mitigate airborne dust.
- G. IT uses a typical three-rack configuration with a B-line seismic for equipment and a standard 19" rack for cabling. Vertical wire management for planning shall be sized at 10" unless otherwise noted on the drawings.

3.2 RACK COMPONENTS AND ELEVATIONS

- A. Owner will develop an equipment layout and rack elevation including the Telecom Room (TR) layouts. Typical components within the TR include, but not limited to:
 - 1. Network Equipment
 - 2. Fiber Termination Unit
 - 3. UPS/ PDU I Power distribution
 - 4. NM2/ NM4/ Horizontal wire management
 - 5. VOIP Router/Voice Gateway
 - 6. VOIP transition equipment
 - 7. Voice cabling
 - 8. Distribution Patch Panels
 - 9. Clinical Engineering Equipment
 - 10. Plug Pack Distribution
 - 11. Camera NVR /Server
 - 12. Nurse Call Devices
 - 13. Overhead Paging Amplifier
- B. See related Sections for materials provided by the Owner and those furnished by the Contractor.

3.3 EXAMINATION

- A. Conditions: Verify conditions, provided under other sections, are acceptable for product installation in accordance with manufacturer's instructions.
- B. Pathways: Verify that pathways and supporting devices, provided under other sections, are properly and permanently installed, and that temporary supports, devices, etc., have been removed.
- C. Field Measurements: Verify dimensions of pathways, including length of pathways. For example, "true tape" the conduits to verify cabling distances.

3.4 FIELD QUALITY CONTROL

- A. Staffing: Provide a qualified foreman who is in charge of the Work and who is present at the job site at times Work is being performed. Supervise the work force executing the Work. Perform the installation within the restraints of the construction schedule.

- B. Project Management: Coordinate and attend weekly status meetings to review the overall progress and issues to be resolved throughout the course of construction. Prepare and distribute meeting agenda prior to and meeting notes after meetings in a format acceptable to the General Contractor.
- C. Scheduling: Prepare an overall construction schedule based on the results of the planning meetings with the General Contractor. Issue schedule to General Contractor for approval. Prepare and issue updated schedules whenever there are modifications.
- D. Inspection: Perform inspection after installation. Keep areas of work accessible and notify code authorities, or designated inspectors, of work completion released for inspection. Document completion, and inspection as required.

3.5 INSTALLATION

- A. Conform to applicable federal, state and local codes, and telephone standards.
- B. Attend one pre-construction meeting with the Owner to coordinate the requirements of the communications systems.
- C. Coordinate the entire installation with the General Contractor, and their subcontractors, to meet the construction schedule. Include coordination meetings as required to fulfill this requirement.
- D. Manufacturer's Instructions:
 - 1. Comply with manufacturer's product data, including product technical bulletins, product catalog installation instructions, and product carton instructions for installation.
- E. Maintain jobsite file and comply with Material Safety Data Sheets (MSDS) for each product delivered to jobsite.

3.6 REPAIR/RESTORATION

- A. Replace or repair work completed by others that you deface or destroy. Pay the full cost of this repair/replacement.
- B. Paint damaged areas to existing painted surfaces caused by Work.
- C. Punch List:
 - 1. Inspect installed work in conjunction with the General Contractor and develop a punch list for items needing correction.
 - 2. Provide punch list to Owner for review prior to performing punch walk with Owner.
- D. Re-Installation:
 - 1. Make changes to adjust the system to optimum operation for final use. Make changes to the system such that any defects in workmanship are correct and cables and the associated termination hardware passes the minimum test requirements.
 - 2. Repair defects prior to system acceptance.
- E. Cleaning

1. Clean daily. Remove temporary coverings and protection of adjacent work areas. Remove unused products, debris, spills, or other excess materials. Remove installation equipment.
2. Leave finished work and adjacent surfaces in neat, clean condition with no evidence of damage.
3. Repair or replace damaged installed products.
4. Clean installed products in accordance with manufacturer's instructions prior to Owner's acceptance. Legally dispose of debris.

3.7 DEMONSTRATION

- A. On completion of the acceptance test, schedule a time convenient with the Owner or Owner's Representative for instruction in the configuration, operation, and maintenance of the system.
- B. Provide 4 hours, minimum, of on-site orientation and training by a factory-trained representative. Document dates and times of training and submit a "sign in" sheet for individuals trained, as part of the close out documentation.

3.8 CERTIFICATION

- A. Provide to Owner or Owner's Representative a written form of acceptance for signature. Corrections must be completed before Owner or Owner's Representative and Engineer will give acceptance.

END OF SECTION

SECTION 27 05 29
HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. The work covered under this section consists of the furnishing of all necessary labor, supervision, materials, equipment, and services to completely execute the provision of communications supports and cable hook system as described in this specification, including but not limited to:
 - 1. Strut supports
 - 2. Cable hooks (J-hooks)
 - 3. Beam clamps
 - 4. Concrete fasteners
 - 5. Touch-up materials
 - 6. Conduit supports
 - 7. Equipment supports
 - 8. Fastening hardware
 - 9. Poke-through device

1.2 SYSTEM DESCRIPTION

- A. Provide devices specified in this Section and related Sections for support of communications equipment specified for this project.
- B. Provide support systems that are adequate for the weight of equipment, conduit and wiring to be supported.

1.3 SEISMIC REQUIREMENTS

- A. Seismic design requirements criteria, as shown on all drawings related to the project, including architectural and structural, as defined below shall apply to all work defined within the following specification sections:
 - 1. SECTION 27 05 00 COMMUNICATIONS HORIZONTAL CABLING
 - 2. SECTION 27 05 26 GROUNDING AND BONDING OF COMMUNICATIONS SYSTEMS
 - 3. SECTION 27 05 36 CABLE TRAYS FOR COMMUNICATIONS SYSTEMS
 - 4. All support systems and termination apparatus associated with the telecommunications system.
- B. Contractor to install seismic restraints for all telecommunications racks and UPS systems. In accordance with construction documents. Include floor mounted items weighing more than 400 pounds and wall mounted or suspended items weighing more than 20 pounds.

- C. Installation according to engineered drawings and anchorage calculations provided by the structural engineer in accordance with California Code of Regulations, Title 24, 2007 California Building Code.
- D. Supports for such items, including racks, conduit, cable trays and similar shall provide support, bracing, and anchorage, designed by the structural engineer in accordance with CBC Chapter 16A.
- E. Supports to be sized to suit load and selected to match mounting conditions

1.4 REFERENCES

- A. Comply with References requirements of Section 27 05 00
- B. In addition to those codes, standards, etc., listed in Section 27 05 00, comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:
 - 1. ASTM A 510 Specifications for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel.
 - 2. ASTM B 633 Specifications for Electrodepositing Coatings of Zinc on Iron and Steel, Sections SC2 and SC3.
 - 3. ASTM A 653 Specifications for Steel Sheet, Zinc-Coated (Galvanized) by Hot Dip Process.
 - 4. ASTM A 591 Specifications for Electrodepositing Coatings of Zinc on steel wire or sheets.
 - 5. ASTM A 123 Specifications for Zinc (Hot Galvanized) Coatings on Iron and Steel.

1.5 DEFINITIONS

- A. Definitions as described in Section 27 05 00 shall apply to this section.
- B. "Cable Hanger": A metal, most often steel, cable support device shaped (section view) similar to the letter J; alternately, a fabric strap. The device is available in different sizes supporting different quantities of cables and is also available with different attachment hardware to be supported by different methods (e.g., wire support, beam flange clip, etc.).
- C. Cable Runway or Ladder Rack: Overhead means to get cabling from point to point whether it be vertical or horizontal within Telecommunications Spaces such as TR's and the TER.
- D. "J-Hook": Another name for cable hangers.

PART 2 - PRODUCTS

2.1 FASTENERS, STRAPS, AND BEAM CLAMPS

- A. Equal products by the following manufacturers will be considered providing that all features of the specified product are provided:
 - 1. Concrete fasteners
 - a. Hilti.

- b. Phillips "Red-Head."
 - c. Remington.
 - d. Ramset.
 - e. Simpson Strong-Tie.
 - f. Or approved equal.
2. Concrete inserts and construction channel:
- a. Unistrut Corp.
 - b. GS Metals "Globe Strut."
 - c. Thomas & Betts.
 - d. "Kindorf" Corp.
 - e. Or approved equal.

3. Conduit straps:
 - a. 0-Z/Gedney.
 - b. Erico "caddy" Fastening Products.
 - c. Thomas & Betts.
 - d. "Kindorf" Corp.
 - e. Or approved equal.
4. Beam Clamps
 - a. Cooper B-line.
 - b. SuperStrut.
 - c. Unistrut.
 - d. Or approved equal.

2.2 CABLE HANGERS

A. Ceiling Hung J-Hooks

1. Specifically intended to carry the load of up to 74 communications cables without applying excess forces to cables at bottom of bundle.
2. Integral broad bottom edge to spread cable load with flat bottom and provide a minimum of 1-5/8" cable bearing surface.
3. Integral hanger rod attachment hardware at top. Load rated for application.
4. Incorporates smooth 90-degree radius edges to prevent snagging cable jackets on installation.
5. Designed so the mounting hardware is recessed to prevent cable damage.
6. Integral mechanical cable latch retainer to provide containment of cables within the hook. The retainer shall be removable and reusable.
7. Suitable for direct attachment to walls, hanger rods, beam flanges, purlins, strut, floor posts, etc.to meet job conditions.
8. Multi-tiered cable hooks to be used where required to provide separate cabling compartments, or where additional capacity is needed.
9. Finishes: cable hooks for non-corrosive areas shall be pre-galvanized steel, ASTM A653. Where additional strength is required, cable hooks shall be spring steel with a zinc-plated finish, ASTM B633, SC3.
10. Cable hooks for corrosive areas shall be stainless steel, AISI Type 304.
11. Manufacturer:
 - a. Cooper B-Line series BCH21, BCH32, BCH64.
 - b. Caddy/Erico cablecat.
 - c. Or approved equal.

PART 3 - EXECUTION

3.1 GENERAL

- A. Comply with the Executive requirements of Section 27 05 00.

3.2 EXAMINATION

- A. Thoroughly examine site conditions for acceptance of supporting device installation to verify conformance with manufacturer and specification tolerances. Notify the University's Representative of conditions that would adversely affect the installation or subsequent utilization of the system. Do not proceed with installation until unsatisfactory conditions are corrected.
- B. Installer is responsible for the integrity of the structures to which the system is attached, including their capability of safely accepting the loads imposed as evaluated by a qualified engineer.
- C. The University's Representative reserves the right to request additional supports where in their sole opinion said supports are required. Any additional supports shall be installed at no additional cost to the University.

3.3 PREPARATION

- A. Prepare and maintain the following clearances from EMI sources (per BICSI Standards).
 - 1. Power cable (in grounded conduit) = 6 inches
 - 2. Power cable (unshielded) = 24 inches
 - 3. Fluorescent lights = 5 inches
 - 4. Transformers = 48 inches
- B. Provide all low voltage Communications Systems Pathways and Electronic Security and Safety System Pathways.

3.4 DISTRIBUTION PATHWAY VIA CEILING HUNG CABLE HOOKS (J-HOOKS)

- A. The cabling support system shall be installed in accordance with the manufacturer's instructions and as indicated on Contractor's submittal documentation, prior to final acceptance/approval by the University.
- B. Provide dedicated supports at sixty inches (60") separation, maximum, per a given route. Suspend wire or rod using components appropriate for the structure – e.g., powder-actuated clip fastener for wire, beam flange clip or angled flange clip for either wire or rod, or an embedded anchor for the threaded rod. Do not share support (wire/rod) with other trades. Do not support the hanger on ceiling grid support wires. Do not support the hanger from ductwork, piping, or other equipment hangers.
- C. Cable Tray cables are not to exceed a 25% fill when the project is complete. 25% fill is a visual fill of 50% of the cable tray.

3.5 CONDUIT

- A. Conduit used for pathway is to be designed with a maximum 40% visual fill.
- B. EZ path retrofit EZDR-400 or EZDR-200 will be provided on all conduits when required for compliance.

3.6 FLOOR BOXES AND POKE THROUGH DEVICES

- A. All Floor boxes shall be sized and approved by UCD IT and FD&C's furniture group.
 - 1. Wiremold RC9AM2TCBK flush poke -thru with accessories as required.
 - 2. One 1-1/4" trade standard, data.
 - 3. One 1-1/2" trade standard, av or other.
 - 4. Floor poke through assembly, dual service feed-through fitting. Commonly used wire mold RC9AM2TCBK flush poke -thru with accessories as required. One 3/4" trade standard and one 1-1/4" trade standard.
 - 5. Wiremold 4ffatcbs flush furniture feed poke -thru with accessories as required.
 - 6. Or approved equal.

END OF SECTION

SECTION 27 05 33
CONDUITS AND BACKBOXES FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Provide telecommunications pathways in accordance with ANSI TIA-569-E, as shown on the plans or as designed by an RCDD.
- B. Provide conduits as required by fire code and where wall cavities are obstructed.
- C. Provide Ring and String where allowed in wall cavities and locations are accessible.
- D. Provide a minimum of a 1 1/4" conduit for wall drops as needed.
- E. All junction boxes shall be sized and designed by a registered RCDD communications designer
- F. Conduit for communications is NOT to adhere to the parallel of the exterior wall configuration required by the electrical specification. Cable Distance is priority for communications cabling and dictates path taken.

1.2 SUBMITTALS

- A. Product Data: For each product indicated.
- B. Submittals are to be approved by IT Facilities Department and consultant.
 - 1. Obtain written approval from the Consultant for the product data submittal prior to materials and equipment purchase order and prior to installation.
 - 2. Format: Submit each product data as an electronic (PDF) document.
 - 3. Labeling: For each submittal, provide a cover page including the following information:
 - a. Client Name
 - b. Project Name and Address
 - c. Submittal Name (e.g., "Product Data Submittal for LCD Panel Backbox.")
 - d. Specification Section Number (e.g., "Section 27 05 33).
 - e. Date of Submittal
 - f. Contractor Name
- C. Submit conduit shop drawings for cable path other than wall drops.
- D. Confirm low voltage pathway quantity and fill ratio expected.
- E. Include junction box locations and sizes.

PART 2 - PRODUCTS

2.1 WORK AREA OUTLET BOX

- A. Work area outlet box
 - 1. 5 square deep boxes on wall drops where required

2.2 JUNCTION BOXES

- A. Junction Boxes
 - 1. Sized to accommodate bend radius of cabling being installed.

2.3 FLOOR BOXES, POKE-THROUGHS AND MONUMENTS

- A. Floor Box, Flush Devices
 - 1. All Floor boxes shall be sized and approved by IT facilities and FD&C's furniture group.
 - 2. Manufacturers
 - a. Wiremold RC9AM2TCBK Flush Poke -Thru with accessories as required.
- B. Floor Poke Through Assembly, dual service feed-through fitting.
 - 1. Commonly used
 - a. Wiremold RC9AM2TCBK Flush Poke -Thru with accessories as required.
 - 1) One 3/4" trade standard
 - 2) One 1-1/4" trade standard
 - b. Wiremold 4FFATCBS Flush Furniture Feed Poke -Thru with accessories as required.

2.4 WIRELESS, SECURITY AND OTHER PERIPHERAL CABLING INSTALLATIONS

- A. Conduit and/or electrical outlet box shall not be installed for wireless access point installations unless required by AHJ or physical conditions of the area.
- B. Consider the device being installed when calling out conduit and housings for security and peripheral devices due to differing requirements.

2.5 FIRE PENETRATIONS

- A. EZ path retrofit EZDR-400 shall be provided where applicable as fire stop materials on all conduits.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

- A. Distribution Pathway via EMT Raceway:

UC DAVIS MEDICAL CENTER
DT1 #1745B CATH LAB REPLACE X-RAY EQUIPMENT
PROJECT NO. 9557230

1. Structured cabling installation is to meet BICSI cable distance limitations. Remaining parallel to the building structure is not a requirement.
2. All ends of conduits shall be cut square, reamed and fitted with insulated bushing.
3. All conduit which passes through firewalls shall adhere to applicable fire code.

3.2 PREPARATION

- A. Fill ratios are to be calculated by the designer and installer during their respective design and installation phases of the project.
- B. Cable Tray cables are not to exceed a 25% fill when the project is complete. 25% fill is a visual fill of 50% of the cable tray.
- C. Conduit used for pathway is to be designed with a maximum 40% visual fill.
- D. EZ path retrofit EZDR-400 or EZDR-200 will be provided on all conduits when required for compliance.

3.3 MOUNTING AND INSTALLATION – WORK AREA OUTLET BOX

- A. Provide back boxes at all wall phones and employee time clocks.
- B. The distance between pull boxes shall not exceed 100 feet.
- C. Conduits exceeding two 90-degree bends shall be upsized to the next trade size and never exceed 240 degrees.
- D. Support and fasten pathway and pull boxes as defined in the electrical specifications.
- E. Conduit purposed for floor box(es) must have the respective conduit turn up in an adjacent or nearby wall or column that is stubbed to nearest accessible ceiling.
- F. Manufacturer's instructions:
 1. Comply with manufacturer's product data, including product technical bulletins, product catalog installation instructions, and product carton instructions for installation.
 2. Maintain jobsite file of Material Safety Data Sheets (MSDS) for each product delivered to jobsite packaged with an MSDS.

3.4 PENETRATIONS

- A. Provide EZ path fire penetrations where applicable.
- B. Provide conduit penetrations per electrical Specifications.

3.5 STATION CABLE PATHWAY INSTALLATION

- A. Work Area Outlet Boxes:

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DT1 #1745B CATH LAB REPLACE X-RAY EQUIPMENT
PROJECT NO. 9557230

1. Unless otherwise noted on the plans, all cut in boxes and surface station outlet boxes are to be installed at a height of 18" A.F.F. (above finished floor) to center, except for those otherwise called out.
2. Those plates or boxes that are to be used for telephone wall jacks shall be installed according to ADA requirements.
3. All cabling outlets shall be installed so that their edges are parallel to the vertical and horizontal edges of the surface on which they are mounted.

3.6 FINAL INSPECTION AND CERTIFICATION

A. Punch Walks and Punch Lists

1. Punching the Work of individual Sections of Division 27 may be combined.
2. Execute a punch walk with the Consultant to observe work.
3. Develop a punch list for items needing correction. Issue this punch list to Consultant.
4. Correct the Work as noted on punch list.
5. Execute follow up punch walk with the Engineer and the Owner or Owner's Representative to verify punch list items have been corrected.

END OF SECTION

SECTION 27 05 53
IDENTIFICATION AND LABELING OF COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Provide all labor, materials, tools, and equipment required for permanent intelligible labeling for items including but not limited to communications cabling (structured and non-structured) innerduct, connectors, faceplates, jacks, receptacles, patch panels, and racks.
- B. All labels will be preprinted, or computer printed type. Handwritten labels are not acceptable
- C. This section includes minimum labeling requirements for the following:
 - 1. Room designations
 - 2. Communications cabling
 - 3. Closet Hardware including patch panels, terminal blocks, protectors and racks
 - 4. Work Area Outlets
 - 5. Wireless Access Points
 - 6. Pathways and Spaces
 - 7. Grounding and Bonding

1.2 VISUAL APPEARANCE

- A. Clear plastic covers over faceplate labels are not permitted.
- B. Shall be preprinted or computer printed type.
- C. Black SMB's are to be labeled with white on black.
- D. Stainless will be labeled with black on white.
- E. White (if required) will be labeled with black on white.

1.3 LABELING STANDARDS AND REQUIREMENTS

- A. All new labeling is to reflect UCD labeling standards.
- B. Contact the University's Representative for a copy of the current standards prior to proceeding.
- C. Bring to the University Representative's attention any project conditions not described in these specifications and the University's current standards and conform to the direction received.
- D. Identification and administration work specified herein shall comply with the applicable requirements of:
 - 1. ANSI/TIA/EIA-606-C Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.

PART 2 - PRODUCTS

2.1 COMMUNICATION CABLING LABELS, GENERAL

- A. Shall meet the legibility, defacement, exposure and adhesion requirements of UL 969.
- B. Shall be preprinted or computer printed type. Handwritten labels are not acceptable.

2.2 COMMUNICATION CABLING LABELS, INTERIOR

- A. Provide vinyl substrate with a white printing area and black print.
- B. If cable jacket is white, provide cable label with printing area which is either orange or yellow, such that the labels are easily distinguishable.
- C. Shall be flexible vinyl or other substrates to apply easy and flex as cables are bent.
- D. Shall use aggressive adhesives that stay attached even to the most difficult to adhere to jacketing.
- E. Manufacturers:
 - 1. Cable Type- 4 pair UTP /4 pair UTP Zero Skew - Panduit S100X125VAC or approved equal.
 - 2. Cable Type- 4 pair STP - Panduit S100X125VAC or approved equal.
 - 3. Cable Type- 25 to 100 pair copper - Panduit S100X650VAC or approved equal.
 - 4. Cable Type- 2 strand fiber - Panduit F100X300AJT or approved equal.
 - 5. Cable Type- 4-12 strand fiber - Panduit S100X125VAC or approved equal.
 - 6. Cable Type- RG-6 and RG-59 Coax - Panduit S100X125VAC or approved equal.
 - 7. Cable Bundles - Panduit UIHL12-XO or approved equal.
 - 8. Other Interior Cabling - Panduit S100X650VAC or approved equal.

2.3 CLOSET HARDWARE LABELS

- A. Shall meet the legibility, defacement, exposure, and adhesion requirements of UL 969.
- B. Shall be preprinted or computer printed type. Handwritten labels are not acceptable.
- C. Location ID:
 - 1. Panduit - White C061X030FJC
 - 2. Panduit - White C750XOSOYIJ
 - 3. Or approved equal.
- D. Non-keystone-based fiber patch panels:
 - 1. Panduit - White C061X030FJC
 - 2. Panduit - White C750XOSOYIJ
 - 3. Or approved equal.
- E. 110 blocks

1. Panduit C750XOSOYIC
2. Panduit S White C750XOSOYIJ
3. Or approved equal.

2.4 GROUNDING AND BONDING, PATHWAY, AND SPACE LABELS

- A. Panduit C200X100FJC or approved equal.

2.5 WORKSTATION LABELS

- A. Panduit - White C061X030FJC
- B. Panduit - White C750X050YIJ or approved equal.

2.6 LOCATION NAMEPLATES

- A. Provide laminated plastic nameplates for each equipment enclosure, rack, switch, and device, as specified.
- B. Comply with ASTM D 709.
- C. Each nameplate inscription shall identify the function and, when applicable, the position.
- D. Nameplates shall be melamine plastic, 0.125-inch thick, black with white center core.
- E. Surface shall be matte finish. Corners shall be square.
- F. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by three inches.
- G. Lettering shall be a minimum of 0.25-inch-high normal block style for location nameplates or a minimum of 1-inch-high normal block style for rack nameplates.
- H. Panduit C300X100APT or approved equal.

2.7 COMMUNICATION CABLING LABELS, OUTSIDE PLANT

- A. Cable Tags in Manholes, Handholes, and Vaults
 1. Provide tags for communications cable or wire located in manholes, handholes, and vaults.
 - a. The tags shall be polyethylene.
 - b. Machine printed - Do not provide handwritten letters.
 2. Polyethylene Cable Tags
 - a. Provide tags of polyethylene that have an average tensile strength of 22.4 MPa (3250 pounds per square inch) 3250 pounds per square inch; and that are two millimeter (0.08 inch) 0.08 inch thick (minimum), non-corrosive non-conductive; resistive to acids, alkalis, organic solvents, and salt water; and distortion resistant to 77 degrees C 170 degrees F.
 - b. Provide 1.3 mm (0.05 inch) 0.05 inch (minimum) thick black polyethylene tag holder.

- c. Provide a one-piece nylon, self-locking tie at each end of the cable tag.
 - d. Ties shall have a minimum loop tensile strength of 778.75 N (175 pounds) 175 pounds. The cable tags shall have black block letters, numbers, and symbols 25 mm (one inch) one inch high on a yellow background.
 - e. Letters, numbers, and symbols shall not fall off or change positions regardless of the cable tags' orientation.
3. Manufacturers:
- a. Panduit
 - b. Brady
 - c. Or equal.

PART 3 - EXECUTION

3.1 GENERAL

- A. Verify all room numbers, racks, conduits, cable tray, cables, equipment housing, vaults and items within this document have been labeled.
- B. Contractor applied labeling shall reflect final space and Telecommunications structure designations.
- C. Accurate labeling shall be provided on the as-built shop drawing submittals.

3.2 IDENTIFICATION AND LABELING

- A. Telecommunications Rooms
 - 1. Labels shall be affixed at the entry to all telecommunications rooms and spaces (Includes entrance facilities, telecommunications equipment rooms, communication equipment spaces and work areas).
 - 2. All IT rooms are numbered but not designated "equipment" due to security concerns.
- B. Cable Tray and Conduits
 - 1. Cable tray structured versus AV or analog systems pathway labeling and designations are the responsibility of the installer to designate the services that are to use the pathway or what portion of the pathway.
 - 2. Any permanent label that is clearly visible is acceptable.
- C. Rack and Cabinet Labeling
 - 1. Provide laminated plastic nameplates for each equipment enclosure, row and rack designations as shown on elevations provided by UCD IT.
- D. Copper Patch Panels – Horizontal
 - 1. Label with Jack numbers.
- E. Tie Cable Patch Panels
 - 1. Label the pair count at the top of the patch panel, separated from all others.

2. Place the cable's identification text centered on the top label strip. (example:18CA75, TIE 1672A).

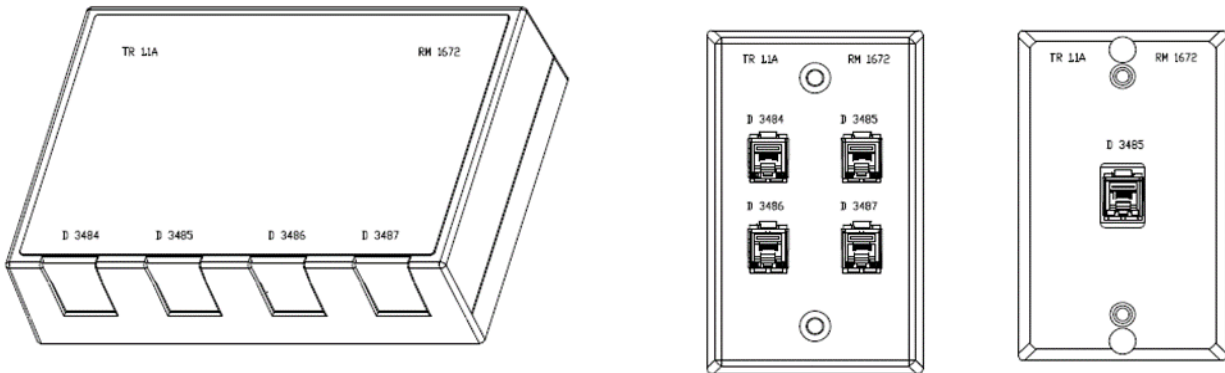
F. 110 Blocks

1. Not used other than MPOE, OSP installation.
2. Label with University provided designation.

G. Workstations

1. Use adhesive type labels and affix labels to faceplate per diagram provided.
2. Provide sequential 4 or (Occasionally 5 digit) jack number (starting dependent on the floor designation) beginning with an X such as X056, X being floor# followed by the closet sequenced cable number.

3. All faceplate labels shall contain the following items:
 - a. Building and Closet Designation such as 34-1100 (building#, IT closet#)
 - b. TR Designation such as TR1.1 or TR 1A (University established designation)
4. Under no circumstances are jacks to be installed with a drop/name or location number as a label or a matrix identifier.
5. See diagram below:



H. Wireless Access Point (WAP) Labeling

1. The University's Representative will provide locations for Wireless Access Point installations with the University's assigned designated identifiers adhered to the Access Point itself.
2. Building Designation / room or area designation – AP / a,b,c (if multiple AP's within room).
3. WAP labeling consists of the Icon being a designated color at the device, Icon being a designated color in the patch panel, and a band being installed on both ends of the patch cord that connects the cable in the TR room.

I. Grounding and Bonding

1. Label the TMGB (telecommunications main ground busbar) with an adhesive label.
2. Label the TGB(s) (telecommunications ground busbar) with an adhesive type label(s).

J. Other Cable Numbering

1. Other cabling types, such as Coax installed in a TR shall be numbered uniquely, such as C=Coax.
2. Cameras and AP's are Data Cabling, which falls into the Data Cabling labeling scheme.
3. Point to point Data Cables require independent numbering such as A1001 for items such as in room video distribution such as N-stream equipment.

K. Fiber Patch Panels

1. Fiber patch panels shall be marked using adhesive labels indicating the range of circuits installed to it. All fiber optic cable patch panels shall be labeled with the pair count of every fiber pair, the cable's assigned identifier, and the patch panel's assigned identifier.
2. All labels shall consist of the following:
 - a. Provide the respective FTU # next in sequence in the data room.

- b. Provide and label each bulkhead in the fiber panel per the following: Fiber Cable #, "FROM" Building / "FROM" Room / "FROM" FTU / Fiber Type / Strand # to Location / Telecom Cable # / "TO" Building / "TO" Room / "TO" FTU / / Strand # / Fiber Type.
 - c. Coordinate with IT before applying any labels.
- L. Fire stopping
 - 1. Each fire stopping location shall be labeled at each location where fire stopping is installed, on each side of the penetrated fire barrier, within 12 in. of the fire stopping material.
 - 2. Labels shall adhere to the requirements set forth by the authority having jurisdiction (AHJ).
- M. Indoor Communications Cables
 - 1. Horizontal and Indoor Backbone cables shall be marked within 12 inches of each endpoint or to innerduct in which the cable is installed.
 - 2. Label each end of each riser cable where the cable terminates.
 - 3. Backbone cables shall be marked at each endpoint and at all intermediate locations, pull/access point or junction boxes through which the cable passes, as well as on each floor and in each room the cable is openly visible in.
- N. Copper Riser Cabling.
 - 1. Label all copper backbone cables of at least 25 pair construction to contain the following information:
 - a. Installation Date
 - b. University Assigned Cable ID: (Example: 70 Tie 0P609).
- O. Fiber Riser cabling.
 - 1. Label all fiber backbone cables to contain the following information:
 - a. Installation Date
 - b. University Assigned cable ID:(Example: IFA134)

END OF SECTION

SECTION 27 15 00
COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.1 SUMMARY

- A. Provisioning, installation, termination, and testing of twisted pair, horizontal cabling in modular furniture and hard wall workstations located throughout the project area. Work under this section will include:
 - 1. Wireless Access Point cabling
 - 2. Printer Stations
 - 3. IP Camera Cabling
 - 4. Monitor and CATV cabling
 - 5. IP Medical Equipment in Exam Rooms
 - 6. All workstation cabling as defined on the construction documents

1.2 TYPICAL WORK AREA OUTLETS

- A. A typical work area outlet (per chair) or (Drop) shall consist of two (2) (Purple end to end) Category 6A Data cables, unless otherwise indicated.
 - 1. When re-cabling a building or office consideration shall be made to add Data Cables to support devices that will continue to be viable after a transition to a VoIP network such as fax machines, fire alarms, elevator phones, pay phones etc.
- B. A typical work area outlet shall have a slack loop of 10 feet at the field end of the run.

1.3 OTHER OUTLET CONFIGURATIONS

- A. Wireless Access Points
 - 1. A typical wireless access point (WAP) Outlet shall consist of two (2) (Purple end to end) Category 6A Data cables, unless otherwise indicated.
- B. Timeclock Outlet
 - 1. A typical time cock outlet shall consist of one (1) (Purple end to end) Category 6A Data cable, unless otherwise indicated.
- C. Other outlet configurations as defined by and coordinated with Owner IT.
- D. All Outlet types listed above shall have a slack loop of 10 feet at the field end of the run.

PART 2 - PRODUCTS

2.1 MODULAR JACK COMPONENTS, GENERAL

- A. Modular Jacks rated Category 6A
 - 1. Panduit Mini-Com CJ6X88TGV.
 - 2. Colored Icons as needed per UCDM service designation.
 - 3. Panduit PAN_CID(XX).

2.2 COPPER CABLING, CATEGORY 6A

- A. High Speed, TIA category 6A Cabling, Plenum Rated
 - 1. General Cable GenSpeed 6A Part No.7141877 Purple
 - 2. General Cable GenSpeed 6A Part No. 7151855 Purple
 - a. Use of the improved Genspeed cable is dependent on availability. Do not default to this cable if lead times are excessive.

2.3 TELECOMMUNICATIONS OUTLET COMPONENTS

- A. Modular Furniture Surface Mount Box, Black
 - 1. Panduit CBXQxBL-A Where x = number of ports
 - 2. Modular Surface Mount Box Attachment System Mini-Com CBM-X
 - 3. Modular Surface Mount Box Blank Insert Panduit CMB(BL)
- B. Faceplate
 - 1. Panduit- Mini-Com Faceplates (CFP (2,4,6)SY I CFP (4,8,10) S-2GY
 - 2. Coordinate finish with Architect prior to submittals
- C. Faceplate Blank Insert
 - 1. Panduit CMB(WH)
- D. Stainless Wall Telephone Outlet
 - 1. Leviton 40223-S (where specified)
- E. One Hole Wall Plate
 - 1. Leviton 84004-40 Stainless where requested.
 - 2. Leviton 80720-W White where requested.
 - 3. Coordinate finish with Architect prior to submittals.
- F. Black Loom
 - 1. Panduit loom CLT100F/CLT150F (choose size appropriate for cable installation quantity)
 - 2. Thomas & Betts black liquid tight EFC150
- G. Duplex In-Line Jack frame, one to four jacks (only where required, NOT standard installation)

1. Panduit Mini-Com 106 Duplex Module Frame

PART 3 - EXECUTION

3.1 CABLING RUN LENGTHS

- A. Distance limitation of the in-wall cabling shall be thoroughly reviewed and calculated to be less than 275' when including the anticipated plug pack cabling length in the telecommunications room (TR).
- B. Contractor to field verify the performance including cable length of the proposed installation in a mockup using the proposed cabling, jacks, raceway and test equipment prior to proceeding.
 1. Locate proposed cable pathway drawing for the upcoming cable run.
 2. Contractor to install One (1) typical copper work area outlet complete with jacks at both ends.
 3. Use the proposed pathway and cabling to the furthest location from the TR.
 4. Install a cable simulating the cable length of the Plug Pack configuration.
 5. The cabling contractor is to perform testing of these cables patched together to determine the true length of this mockup.
 6. Test Results are to be inspected and reviewed by the University's Representative prior to proceeding with the rest of the installation.
 7. Any deficiencies in the installation of the mockup are to be corrected by the Contractor and re-inspected by the University's Representative prior to proceeding with the rest of the installation.

3.2 MODULAR JACK COMPONENTS

- A. Category 6A Data Jacks performance shall meet requirements as defined in TIA standards.
- B. Follow manufacture's Installation procedures.

3.3 TELECOMMUNICATIONS OUTLET EXECUTION

- A. Modular Furniture Surface Mount Box, One to Four Jacks
 1. Surface mount box magnetically attached to furniture.
 2. Removing knockouts in the base of the furniture shall be avoided.
- B. Telecommunications Outlets. New, Copper Jacks, Wall Mount, Flush Mount Assembly.
 1. Complete outlet assembly, including but not limited to:
 2. Faceplate with manufacturer's standard jack openings
 3. Blank connector modules at faceplate openings not filled with connector modules.
 4. Features: Single gang with openings for the required number of cables. Provide flat stainless steel.
 5. Features: Double gang with openings for the required number of cables. Provide flat stainless steel.

C. Voice Telephone Station Plates and Jacks (special provision)

1. Wall Mounted Analog Telephone
2. Wall mounted IP Telephone Station
3. Single outlet wall plate w8P8C data Jack

3.4 COPPER CABLING DATA VOICE/DISTRIBUTION

A. Maintain the following clearances from EMI sources (Per BICSI Standards)

1. Power cable – 6 in.
2. Fluorescent Lights - 12 in.
3. Transformers- 48 in.

B. Monitor cable length limitations.

1. All cable installations shall be continuous, un-spliced runs
2. All wiring above ceilings shall be installed in cable tray or cable hangers.
3. Cable in accessible ceilings shall be supported 5' on center (min) attached to building structure.
4. Cable shall have no physical defects such as cuts, tears or bulges in the outer jacket.
5. Cables jackets that are chaffed or burned exposing internal conductor insulation or have any bare copper ("shiners") shall be replaced.
6. Limit cable bends to a minimum radius of 4 times cable diameter except where otherwise noted herein.
7. Refrain from exceeding fill ratio on horizontal cabling installations
8. Service loop at ALL TERMINATIONS
9. Provide slack, which is to be no less than 2.5" and no greater than 5.0", in the station cable at the station outlet end. The Work Area Outlet shall provide enough slack to be serviceable without excess.
10. Service loop at outlet locations: Provide a (10') Ten Foot Slack Loop for all horizontal cabling.
11. All data and voice station cable shall be terminated at the individual receptacle modules in accordance with ANSI/TIA-568-C, assignment T568B.

3.5 TESTING

- A. All system cabling and terminations shall be installed in accordance with manufacturer's instructions and as indicated on Contractor's submittal documentation, prior to final acceptance/approval by the University.
- B. Installation shall be performed and accomplished in a professional manner, by qualified personnel.

3.6 PERFORMANCE STANDARDS

- A. Horizontal (Station) category 6A Copper cabling - Permanent Link

1. Testing shall commence while the University's equipment in the area of service is operational and creating worst case emissions associated with its operation while in good working order. Every effort shall be made to include worst case influence on the materials installed shall be taken.
 2. In accordance with the field test specifications defined in TIA-568-C.2 "Commercial Balanced Twisted-Pair Telecommunications Cabling and Components Standard", every horizontal station cabling link in the project shall be tested for:
 - a. Wire Map Length Insertion Loss NEXT Loss
 - b. PS NEXT Loss
 - c. ACR-F Loss
 - d. PS ACR-F Loss
 - e. Return Loss
 - f. Propagation Delay
 - g. Delay Skew
- B. Using the listed category 6A cable test set, test installed cabling using Permanent Link procedure and submit report demonstrating that the link meets the following:
1. Each permanent link shall demonstrate a positive PSACR beyond 350 MHz to meet and exceed the bandwidth requirements of TIA-568-C.2 Category 6A standards.
 2. Each permanent link shall demonstrate 2 dB of cross talk headroom over TIA -568-C.2 Category 6A standard for NEXT, PSNEXT, ELFEXT and PSELFEXT bit error rate.
 3. Report whether tested link passes or fails.
 4. Note exceptions to required Category standards. Remedy and retest.
 5. Test and report on each intermediate cabling segment separately, including station cabling, horizontal distribution (each segment, if multiple) and telecommunications room wiring.
 6. Test each end-to-end cable link
 7. Submit machine-generated documentation and raw data of all test results on Contractor-provided, and University's Representative approved, forms; and in electronic format approved by the University's Representative.
 8. Test stations wire only after all pairs of station wire in a work area have been terminated at both ends, and no work of this Section or other Sections may cause physical disturbance to the wiring.
 9. Correct any and all transpositions found. Retest.
 10. If any conductor in a station wire tests either open or short, then the entire station wire is to be removed, replaced, and re-tested.
 11. The Contractor shall test all cables and submit all horizontal copper cable test result data in electronic format, with the resulting file formatted with one test result per 8.5"x 11" page. Export or Download the test results from the cable tester to a *.txt format or other accepted proprietary format for submission.
 12. Data found to be altered from the manufacturers recommended settings may result in retention by the University of a 3rd Party Test Company to retest the installed cabling at the expense of the Contractor.
 13. Events exceeding industry standards will cause the test result to be rejected. Direct review by UCD IT will be required to allow for an exception of a test result.

14. Data found to be incomplete may result in retention by the University of a 3rd Party Test Company to retest the installed cabling at the expense of the Contractor.
15. Contractor shall submit (1) copy of software capable of viewing the electronic test result files. Testing Results shall be reviewed and verified by the University before payments are remitted.

C. Test Equipment

1. Contractor shall provide all test equipment as required to perform the scope of work.
2. Test the communication systems cabling using at least one (1) each of the following test measurement devices or their functional equivalents:
 - a. Level III field testers as defined in TIA-1152 - Fluke DSX-5000, or equal.
 - b. The tester including the appropriate interface adapter must meet the specified accuracy requirements. The accuracy requirements for the permanent link test configuration (baseline accuracy plus adapter contribution) are specified in Table 4 of TIA-1152
 - c. The RJ45 test plug shall fall within the values specified in TIA-568-C Annex C for NEXT, FEXT and Return Loss.
 - d. The tester interface adapters must be of high quality and the cable shall not show any twisting or kinking resulting from coiling and storing of the tester interface adapters.
 - e. In order to deliver optimum accuracy, permanent link interface adapter for the tester shall be used, which can be calibrated to extend the reference plane of the Return Loss measurement to the permanent link interface.
 - f. The contractor shall provide proof that the interface has been calibrated within the period recommended by the vendor.
 - g. To ensure that normal handling on the job does not cause measurable Return Loss change, the adapter cord cable shall not be of twisted-pair construction.
 - h. Site portable communications systems (walkie-talkie, cell phone, or similar to aid in communications between test device locations)

END OF SECTION

SECTION 27 52 23
NURSE CALL CODE BLUE SYSTEMS

GENERAL

1.1 SUMMARY

- A. The work covered under this Section consists of the complete installation and integration of a Nurse Call system.
- B. The Owner is defined herein as "UCDH" which represents University of California Davis Health and specifically includes IT Facilities, IT Facilities Infrastructure, IT Facilities Engineering, Network Operations, Auxiliary Services, and other relevant UCDH departments and representatives.
- C. All work in OSHPD-1 Hospital and associated facilities shall be executed in accordance with the requirements of UCDH Infection Control Risk Assessment (ICRA) and Pre-Construction Risk Assessment (PCRA) requirements, standards, forms, policies, and procedures.

1.2 SYSTEM DESCRIPTION

- A. Each Nurse Call system shall be capable of operating as a stand-alone system, with the ability of interfacing to the existing Hospital-wide Nurse Call network.
 - 1. Nurse Call Master Stations
 - a. The Nurse Call Master Stations (NCMS) shall be at the caregiver stations and as indicated on the Drawings. The NCMS shall be the primary call annunciation point for the Nurse Call system. Each NCMS shall consist of a full color touchscreen monitor and an alphanumeric display microphone, keypad, and handset.
 - 2. Nurse Call Central Station
 - a. The Nurse Call Central Station shall be located in the Telecommunications Room (TR) as indicated on the Drawings. The Nurse Call Central Station shall be the primary processing point of the Nurse Call system.
 - 3. Patient Stations
 - a. Patient stations shall provide the interface between the patient and the NCMS. Each Patient Stations will display on its face plate a light indicating a call has been placed and a separate light indicating an open audio path. Each patient station shall be able to accept input from peripheral devices including emergency stations, staff presence stations, remote switches, and auxiliary devices. Patient stations shall be microcomputer based.
 - 4. Staff Stations
 - a. Staff stations shall provide an interface between the nursing staff and the nurse control station. Each Staff Stations will display on its face plate a light indicating a call has been placed and a separate light indicating an open audio path. Each staff station shall be able to accept input from peripheral devices including emergency stations, staff presence stations, remote switches, and auxiliary devices. Staff stations shall be microcomputer based.
 - 5. Emergency Stations

- a. Provide emergency pull cord stations in the toilets and in other locations as indicated on the Drawings. Stations shall meet UL waterproof requirements. The faceplate shall be electrically isolated from internal electrical components.
- 6. Corridor Lights
 - a. Provide corridor lights at the entrance to the patient rooms (dome lights) and in the corridors to indicate the wing of a patient call (zone lights) as indicated on the Drawings.
- 7. Smart Dome Lights
 - a. Provide smart dome lights at locations indicated.
- 8. Staff Presence Stations
 - a. Provide wall mounted recessed manual staff presence stations at the locations indicated on the floor plans. These stations shall report back to the NCMS monitoring the patient room.
- 9. Entertainment and Environmental Interface Units
 - a. Provide recessed mounted interface units for the patient entertainment system (television) and the patient-controlled lighting fixture for each bed. Interface units may not be shown on the Drawings but shall be installed in a location accessible from the patient room. These units shall provide control of the television set and lighting fixture through the patient control unit and patient station.
- 10. Vocera
 - a. Provide Vocera paging capability for each of the caregiver stations. These systems shall operate in either a manual mode or an automatic mode, as selected from the NCMS.

1.3 SEISMIC DESIGN REQUIREMENTS

- A. Identify each item requiring seismic restraint installation in accordance with CBC Chapter 16A. Include floor mounted items weighing more than 400 pounds and wall mounted or suspended items weighing more than 20 pounds.
- B. Supports for such items, including racks and rack cabinets, conduit, cable trays and similar, shall be provided support, bracing, and anchorage designed by the Contractor in accordance with the following criteria:
 - 1. Design to resist seismic forces in accordance with CBC Chapter 16A.
 - 2. Minimum Design Parameters - As defined for the Building, with respect to Occupancy Category, Site Classification, Seismic Design Category, Importance Factor, and Spectral Response Acceleration.

1.4 REFERENCES

- A. American National Standards Institute (ANSI)
- B. American Society for Testing and Materials (ASTM)
- C. Building Industry Consulting Services International (BICSI)
- D. Institute of Electrical and Electronic Engineers (IEEE)

- E. National Electrical Manufacturers Association (NEMA)
 - F. National Fire Protection Association (NFPA)
 - G. Telecommunications Industry Association (TIA)
 - H. Underwriters Laboratories, Inc. (UL)
 - I. California Building Standards Code (California Code Of Regulations, Title 24), 2019
 - J. Public Safety (California Code of Regulations, Title 19), 2021
 - K. Office of the California State Fire Marshal (CSFM) Building Materials Listing (BML) Program
 - L. NFPA 70 National Electrical Code (NEC), 2020
 - M. NFPA 70 National Electrical Code (NEC), Chapter 8 Communications Systems, Article 800 Communications Circuits, 2020
 - N. NFPA 99 Health Care Facilities Code, 2021
 - O. ANSI/TIA-568.0 Generic Telecommunications Cabling for Customer Premises, Rev. E, 2020
 - P. ANSI/TIA-568.1 Commercial Building Telecommunications Infrastructure Standard, Rev. E, 2020
 - Q. ANSI/TIA-568.2 Balanced Twisted-Pair Telecommunications Cabling and Components Standard, Rev. D, 2018
 - R. ANSI/TIA-568.3 Optical Fiber Cabling and Components Standard, Rev. D, 2016
 - S. ANSI/TIA-568.4 Broadband Coaxial Cabling and Components Standard, Rev. D, 2017
 - T. ANSI/TIA-569 Telecommunications Pathways and Spaces, Rev. E, 2019
 - U. ANSI/UL 2900-1 Standard for Software Cybersecurity for Network-Connectable Products, General Requirements, 2020
 - V. ANSI/UL 2900-2-1 Software Cybersecurity for Network-Connectable Products, Particular Requirements for Network Connectable Components of Healthcare and Wellness Systems, 2020
 - W. ANSI/UL 2900-2-3 Standard for Software Cybersecurity for Network-Connectable Products, Particular Requirements for Security and Life Safety Signaling Systems, 2020
- 1.5 SUBMITTALS
- A. Procurement and installation shall not begin until product data and shop drawings submittals have been approved by UCDH.
 - B. Submit product data submittals to UCDH for review and approval.
 - 1. Submit product data submittals system, product, device, and equipment product data cutsheets.

2. Manufacturer's published cutsheets shall be marked with boxes, arrows, highlighting, lines, and notes as needed to clearly indicate the exact product make, model, and options to be provided.
 3. Mark cutsheets to indicate the associated Section.
 4. Provide documentation of Contractor's factory-trained and authorized service representatives.
 5. Compile system, product, device, and equipment product data cutsheets, including templates, graphics, tables, diagrams, and installation instructions, in Adobe Acrobat or Bluebeam Revu complete with a Table of Contents linked to the bookmarks within the submittal and submit an electronic copy in .pdf format.
- C. Submit shop drawings submittals to UCDH for review and approval.
1. Submit shop drawings submittals including device and equipment locations.
 2. Prepare floor plans including room names, room numbers, and door numbers indicating all device locations labeled with unique device name and number.
 3. Include point-to-point drawings of systems, wiring diagrams of individual devices, equipment elevations, and installation details.
 4. Indicate wall space and rack space requirements.
 5. Indicate IP addresses, Ethernet switch ports, and fiber connectivity requirements.
 6. Indicate and label access controlled zones and electronic personal protection system secure zones, where applicable.
 7. Indicate which devices are to be controlled, and which areas and rooms are to be monitored, by a designated nursing station, where applicable.
 8. Include user defined information per floor and per system component.
 9. Compile shop drawings in AutoCAD and submit an electronic copy in .pdf format.
- D. Submit Operation and Maintenance Manual (O&M) submittals to UCDH for review and approval.
1. Prepare O&M manual in 8-1/2" x 11" letter size sheet format, labeled, grouped, and ordered, with bookmarks as indicated in a Table of Contents.
 2. Include manufacturer's system and product data sheets, operation and maintenance information, troubleshooting and servicing instructions, routine maintenance instructions, and copies of all programming sheets.
 3. Provide a copy of the final approved acceptance testing reports and documentation.
 4. Reflect final UCDH occupancy room numbers in the O&M manuals, programming sheets, and system programming.
 5. Compile system, product, device, and equipment documentation (including graphics, tables, and diagrams) complete with a Table of Contents linked to the bookmarks within the manual and submit an electronic copy in Adobe Acrobat or Bluebeam Revu .pdf format.
- E. Submit as-built drawings submittals to UCDH for review and approval.
1. As work progresses, maintain field redlines of actual installation conditions, including device, equipment, and cabling locations.
 2. At project close-out, transfer these redlines to as-built drawings in AutoCAD format.
 3. Reflect final UCDH occupancy room numbers on as-built drawings, programming sheets, and system programming.

4. Include floor plans clearly indicating all device locations labeled with unique device name and number.
5. Indicate and label access controlled zones and electronic personal protection system secure zones, where applicable.
6. Indicate which devices are to be controlled, and which areas and rooms are to be monitored, by a designated nursing station, where applicable.
7. Compile as-built drawings in AutoCAD and submit an electronic copy in AutoCAD .dwg and in Adobe Acrobat or Bluebeam Revu .pdf format.

1.6 QUALITY ASSURANCE

- A. All materials, equipment and parts comprising the units specified herein shall be new and unused, and of current manufacturer.
- B. Units and components offered under this Section shall be covered by the manufacturer's warranty for a minimum of two years from date of UCDH acceptance of the project, a copy of which shall be included in the shop drawings submittals. Submitted system shall have been used on at least five projects of similar size and scope as this project. A reference of these similar systems shall be provided.
- C. Vendor shall provide 24×7×365 support to validate features and functionality for a period of 30 days following the opening of the unit.
- D. A factory-trained and authorized service representative shall perform the work of this Section.
- E. 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 UCDH representative. Including equipment not manufactured by West Com.
 1. Provide spare parts minimum of 10% of each item or 1 whichever quantity is greater.

1.7 WARRANTY

- A. Contractor shall provide labor and hardware repairs and replacement for a period of one year following the acceptance of the installation.

PRODUCTS

2.1 DEVICES

- A. General
 1. UCDH has a sole source agreement with West-Com Nurse Call Systems, Inc. for all Nurse Call systems.
 2. UCDH uses West-Com Novus in clinic environments and West-Com Novus Connect in Hospital environments.
- B. NURSE CALL MASTER STATIONS

- C. NURSE CALL CENTRAL STATIONS
- D. PATIENT STATIONS
- E. STAFF STATIONS
- F. EMERGENCY STATIONS
- G. CORRIDOR LIGHTS
- H. SMART DOME LIGHTS
- I. STAFF PRESENCE STATIONS
- J. ENTERTAINMENT AND ENVIRONMENTAL INTERFACE UNITS
- K. VOCERA INTEGRATION

2.2 GENERAL

A. System Operation and Description

1. The Nurse Call system shall provide a minimum but not limited to:
 - a. Enables a patient to alert a nurse of the need for any type of assistance
 - b. Provides a visual indication of where services are required
 - c. Must provide an audible signal indicating a call on the system
 - d. Must adhere to the state health department requirements
 - e. Must page or provide a wireless means of communicating to nursing staff
 - f. Must provide patient services from bed side, rest room or shower
 - g. Must be able to integrate with Patient bedside TV controls
 - h. Must be able to integrate with room lighting controls
 - i. Must be able to integrate with existing Nurse Call systems
 - j. Must be able to provide nursing statistics of responses
 - k. Must be able to provide manual locaters indicating a staff presence in a room
 - l. Must integrate with other devices, seizure alarm equipment, ventilators, and other auxiliary devices as required
 - m. Must be Ethernet network compatible
 - n. Must be able to be programmed to be supported from any nursing station on the floor or in the Hospital
2. Complete Vocera interface.
3. Complete Electronic Medical Records (EMR) integration.

EXECUTION

3.1 GENERAL

- A. Coordinate with UCDH representatives the location, physical wall and rack space, power, and network connections required in designated Telecommunications Room (TR) for the installation of systems, products, devices, equipment, and enclosures in this Section.
- B. All materials and labor required to produce a completely operational and fully functional system shall be supplied by the Contractor. It will be the responsibility of the Contractor to conform to the requirements of this Section for system operation, final connection, testing, turnover, and warranty compliance.
- C. Network cable and patch cables shall be provided in accordance with the requirements of Division 27 Communications Sections.

3.2 PREPARATION

- A. Thoroughly examine site for acceptance of device installation to verify conformance with manufacturer and UCDH requirements.
- B. Validate that the system is meeting the customers' needs and feature set at UCDH.
 - 1. Coordinate with construction management on scheduling details.
 - 2. Coordinate with UCDH to provide IP addresses.
 - 3. Coordinate with UCDH for fiber connectivity.
 - 4. Verify antivirus software and security updates have been installed per UCDH Security Standards.
 - 5. Coordinate Nurse Call network cabling with the structured cabling package in accordance with Division 27 Communications requirements.

3.3 INSTALLATION

- A. Install a fully functional Nurse Call System as required and approved by UCDH for the project
 - 1. No electrical outlet splitters allowed. Hospital approved UPS or power strip is acceptable.

3.4 LABELING

- A. All system products, devices, equipment, power supplies, cabling, conduits, patch panels, and patch cables shall be labeled with their unique device name and number.
- B. Labeling shall match the text and nomenclature in the programming sheets, system programming, and on the as-built drawings.
- C. Labels shall be machine printed on adhesive labels. Handwritten labels are not acceptable.
- D. The font shall be at least 1/8 inch in height, block characters, and legible. The text shall be black characters on a white background.

3.5 EXAMINATION / ACCEPTANCE

- A. Contractor shall conduct and document System Functional Testing and Onsite Acceptance Testing. System Functional Testing shall be performed by Contractor to ensure that the system is fully functional and completely operational in accordance with the requirements of this Section. Onsite Acceptance Testing shall be performed with UCDH representatives to demonstrate the operation of the completed system.
 - 1. Onsite Acceptance Testing shall only be performed after the System Functional Testing is approved and accepted.
 - 2. Contractor shall provide all personnel and equipment necessary to perform the System Functional Testing and the Onsite Acceptance Testing.
 - 3. Punch list items from the System Functional Testing and Onsite Acceptance Testing shall be satisfactorily resolved by the Contractor prior to UCDH issuing a written notice of acceptance.
- B. System Functional Testing:
 - 1. At least ten working days (two weeks) prior to the scheduled Onsite Acceptance Testing date, Contractor shall provide printed System Functional Testing documentation indicating each device has been successfully tested and is in conformance with the operational intent outlined in the Contract Documents.
 - 2. Printed System Functional Testing documentation should clearly indicate any remaining outstanding items, issues, and punch list items.
 - 3. Failure to provide printed System Functional Testing documentation will prevent Onsite Acceptance Testing from being conducted.
- C. Onsite Acceptance Testing:
 - 1. After approval and acceptance of the printed System Functional Testing documentation, Contractor shall perform Onsite Acceptance Testing in collaboration with the UCDH representative.
 - 2. Upon completion and resolution of all remaining outstanding punch list items, Contractor shall perform follow-up Onsite Acceptance Testing in collaboration with the UCDH representative.
 - 3. Upon successful completion of the follow-up Onsite Acceptance Testing, resolution of all punch list items, delivery and acceptance of the final printed System Functional Testing documentation, and delivery and acceptance of the O&M manuals and as-built drawings, UCDH shall issue a written notice of acceptance, the project shall be considered substantially complete, and the warranty period shall begin.

3.6 DEMONSTRATION AND TRAINING

- A. Provide the services of a factory-authorized service representative to demonstrate and train UCDH maintenance personnel as described below.
- B. Train personnel in the procedures and schedules involved in operating, troubleshooting servicing, and preventive maintenance of the systems. Provide a minimum of 16 hours training. Training shall be scheduled in more than one session, as agreed-upon by Contractor and UCDH.
- C. Train caregiver personnel in proper use of the systems. Periods of training shall be coordinated with the UCDH representative to assure all nursing shifts receive the required training.

- D. Schedule all training through the UCDH representative a minimum of 14 days in advance.
- E. Provide on-site assistance in adjusting sound levels and adjusting controls to suit actual occupied conditions on an as-requested basis for the first year of operation. Provide a minimum of six visits to the site for this function.
- F. Provide completed documentation of all tests as provided by the UCDH representative. Complete repairs at the time of inspections and review.
- G. Vendor shall provide 24×7×365 support to validate features and functionality for a period of 30 days following the opening of the unit. 2-hour response time required.
- H. Provide spare parts to UCDH at the time of building occupancy. The UCDH representative shall provide to the Contractor a list of spare parts to be purchased and shall notify the Project Manager of the required purchase of spare parts acceptable to all parties.
- I. Deliver and obtain a receipt for spare parts from the designated UCDH representative.
- J. Comply with AHJ to provide a fully functional system to comply with state and local codes and authorities to provide a compliant Nurse Call system.

END OF SECTION

SECTION 28 46 00
FIRE DETECTION AND ALARM

PART 1 - GENERAL

1.1 SUMMARY

- A. The work covered under this Section consists of the furnishing of all necessary labor, supervision, materials, equipment, and services to completely execute the provision of a new or modification of an existing Fire Alarm System.

1.2 SYSTEM DESCRIPTION

- A. The work covered under this Section consists of the furnishing of all necessary labor, supervision, materials, equipment, and services to completely execute the provision of a new or existing fire alarm system including, addressable initiating and signaling devices, conduit, boxes, wiring, annunciator panels and other components as required for a functional system as described in this Section. This system shall be an addressable, analog, general alarm, supervised, 24-volt DC fire detection and alarm system.
 - 1. Provide manual pull station and connect to the Notifier 3030 fire alarm panel, where indicated or required by code.
 - 2. Provide combination synchronized horn and visual alarm devices and connect to the Notifier fire alarm control panel, where indicated or required by code.
 - 3. Provide smoke detectors and heat detectors and connect to the Notifier control panel, where indicated or required by code.
 - 4. Provide duct smoke detectors and connect to the Notifier control panel, where indicated or required by code.

1.3 SEISMIC DESIGN REQUIREMENTS

- A. Identify each item requiring seismic restraint installation in accordance with CBC Chapter 16A. Include floor mounted items weighing more than 400 pounds and wall mounted or suspended items weighing more than 20 pounds.
- B. Supports for such items, including racks and rack cabinets, conduit, cable trays and similar, shall be provided support, bracing, and anchorage designed by the Contractor in accordance with the following criteria:
 - 1. Design to resist seismic forces in accordance with CBC Chapter 16A.
 - 2. Minimum Design Parameters - As defined for the Building, with respect to Occupancy Category, Site Classification, Seismic Design Category, Importance Factor, and Spectral Response Acceleration.

1.4 RELATED SECTIONS

- A. Division 27 Communications Sections

1.5 REFERENCES

- A. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems
- B. State Rules and Regulations applicable to Hospitals and Homes for the Aged, promulgated by State Department of Health and California State Fire Marshal.
- C. California Building Code (CBC).
- D. California Electrical Code (CEC), including Article 760.
- E. Factory Mutual FM approved.
- F. Approved by California State Fire Marshal and Title 19.
- G. NFPA 101 Life Safety Code.
- H. California Code of Regulations TITLE 24 Parts 2, 3, , 9, & 12.
- I. NFPA 72 National Fire Alarm and Signaling Code.
- J. UL 38 Standard for Manually Actuated Signaling Boxes for Use with Fire-Protective Signaling Systems.
- K. UL 217 Standard for Smoke Alarms.
- L. UL 268 Standard for Safety Smoke Detectors for Fire Alarm Systems.
- M. UL 464 Audible Signaling Devices for Fire Alarm and Signaling Systems, Including Accessories.
- N. UL 521 Heat Detectors for Fire Protective Signaling Systems.
- O. UL 864 Standard for Control Units and Accessories for Fire Alarm Systems.
- P. California Electrical Code

1.6 SUBMITTALS

- A. Conform with the requirements of Division 01 and Division 26 UCDH Electrical Specification Common Work Results for Communications and the following:
- B. Submit the following shop drawings indicating any necessary changes to engineering drawings including but not limited to:
 - 1. A device legend with a bill of materials and California State Fire Marshal listing numbers for each device type showing exact types and quantity of all fire alarm devices.
 - 2. A sequence of operations to show how system will react to the activation of each type of device.
 - 3. A wire list that shows the wire type, gauge and conductor count for all wires and cables.
 - 4. Floor plans showing the entire project area, all fire alarm devices, conduit, and wire routing. Room numbers and room use label 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 within the conduit. Indicate the location and type for all fire rated walls and partitions.

5. Single Line Riser Diagram.
 6. Point to Point details that indicate the interconnections between the control equipment components and the termination location for initiating devices and notification appliances.
 7. Elevation drawing showing all fire alarm equipment enclosures and raceways on the wall where they will be installed. termination and connection points within the enclosure shall not be mounted higher than 6-feet above finished floor. System status displays shall be at 56-inches AFF.
 8. Elevation details for all wall and ceiling-mounted devices.
 9. Support and anchorage details for any fire alarm equipment weighing over 20 pounds.
 10. Details and UL listing number of through-penetration fire stop system(s) to be installed.
 11. No equipment shall be located under a cabinet containing batteries.
 12. The system shall be designed, and the shop drawings shall indicate that the control panel has 25% capacity left for expansion of modules, initiating device circuits, device capacity on signaling line circuits, notification appliance circuits and on door release circuits.
 13. Complete operating and maintenance manuals listing the manufacturer's name(s) including technical data sheets shall be submitted simultaneously with shop drawings.
 14. Provide clear and concise operating instructions that gives, in detail, all information required to properly operate the fire alarm equipment and system.
 15. Incomplete submittals will be rejected.
- C. Submit as a portion of your submittal package the following, in PDF format, if not provided on shop drawings:
1. Equipment cut sheets for each device provided for the project with the California State Fire Marshal listing sheet with current expiration date for each component. 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.
 2. 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..
 3. Voltage drop calculations which shall be point to point on indicating device circuits.
 4. Device address list with device descriptions and labels / messages as they are to be programmed into the FACU for each device shown on submittals.
 5. A check off list of all items to be reviewed and validated during the final acceptance of this installation.
 6. Validation of a 2-year warranty on materials and installation.

1.7 QUALITY ASSURANCE

- A. All materials, equipment and parts comprising the units specified herein shall be new and unused.
- B. Provide documentation stating that spare parts will be continued to be manufactured or will be stocked and available for a minimum of 5 years after the complete system acceptance by UCDH.

- C. All materials shall be manufactured by Notifier, no equal, to comply with University standards.
- D. Execution and validation documentation shall include but not be limited to programming documentation. Inaccuracies in documentation shall be included in Contractor's 2-year warranty package and shall be revised and verified accurate at no additional cost to UCDH.

1.8 WARRANTY

- A. Provide 2-year warranty on materials and installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- 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 published instructions and 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 SYSTEM DEVICES

- A. Addressable Manual Fire Alarm Box (manual station)
 - 1. Notifier model NBG-12LX
- B. Intelligent Photoelectric Smoke Detector
 - 1. Notifier model FSP-851 Head with Notifier model B501 base.
- C. Intelligent Ionization Smoke Detector
 - 1. Notifier model FSI-851 head with Notifier model B501 base
- D. Intelligent Thermal Detectors
 - 1. Notifier model FST-851 head with Notifier model B501 base.
- E. Intelligent Duct Smoke Detector
 - 1. Notifier model FSP-851R Head with Notifier model DNR housing.

2. 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 UCDH Fire Department for direction.
- F. Addressable Dry Contact Monitor Module
1. Notifier model FMM-1.
- G. Two Wire Detector Monitor Module
1. Notifier model FZM--1.
- H. Addressable Control Module
1. Notifier model FCM-1.
- I. Addressable Relay Module
1. Notifier model FRM-1.
- J. Isolator Module
1. Notifier model ISO-X.
- K. Horn/Strobe
1. Wall mount – System Sensor model P2RL
 2. Ceiling Mount – System Sensor SGRL
- L. Strobe
1. Wall mount – System Sensor model SC2RL
 2. Ceiling Mount – System Sensor SCRL
- M. Remote Annunciator
1. Notifier LCD2-80
- N. 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 Control. The control System shall be field programmable for either 90A operation or 92A/B operation to allow for future use and system expansion.
 - a. 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.
 2. 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.

3. All HVAC switches (i.e., limit switches, vane switches, etc.) shall be provided and installed by the HVAC contractor.
4. It shall be possible to meet the requirements mentioned above utilizing wall mounted custom graphic.

2.3 BATTERIES AND EXTERNAL CHARGER

A. Battery

1. 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.

2.4 FIRE ALARM CONTROL PANEL

- A. The main FIRE ALARM CONTROL PANEL shall be 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. 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.
- C. 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 UCDH or Contractor.
- D. In conjunction with intelligent Loop Control Modules and Loop Expander Modules, the main FIRE ALARM CONTROL PANEL 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 display the location of the alarm condition on the FIRE ALARM CONTROL PANEL and all system annunciators. 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 all Notification Appliance Circuits.
 4. Visually and audibly annunciate any trouble, supervisory, security or alarm condition on operator's terminals, panel display, and annunciators.

- E. When a fire alarm condition is detected and reported by one of the fire alarm initiating devices, the following functions shall immediately occur:
1. The system alarm LED shall flash.
 2. A local piezo-electric audible device in the control panel shall sound a distinctive signal.
 3. 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.
 4. Printing and history storage equipment shall log and print the event information including with a time and date stamp.
 5. All system outputs assigned via preprogrammed equations for a particular point in alarm shall be executed, and the associated system outputs (i.e. alarm notification appliances and/or relays, etc.) 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:
1. The system trouble LED shall flash.
 2. A local piezo-electric audible device in the control panel shall sound a distinctive signal.
 3. 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.
 4. Printing and history storage equipment shall log and print the event information along with a time and date stamp.
 5. 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.
- G. When a supervisory condition is detected and reported by one of the system initiating devices or appliances, the following functions shall immediately occur:
1. The system trouble LED shall flash.
 2. A local piezo-electric audible device in the control panel shall sound a distinctive signal.
 3. The 640-character backlit LCD display shall indicate all information associated with the supervisory condition, including the type of trouble point and its location within the protected premises.
 4. Printing and history storage equipment shall log and print the event information along with a time and date stamp.
 5. All system outputs assigned via preprogrammed equations for the particular active point shall be executed, and the associated system outputs (notification appliances and/or relays) shall be activated.
- H. When a pre-alarm condition is detected and reported by one of the system initiating devices or appliances, the following functions shall immediately occur:
1. The system pre-alarm LED shall flash.
 2. A local piezo-electric audible device in the control panel shall sound a distinctive signal.
 3. 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.

4. Printing and history storage equipment shall log and print the event information along with a time and date stamp.

2.5 FIRE ALARM CONTROL PANEL

- A. The main FIRE ALARM CONTROL PANEL shall be NOTIFIER Model NFS2-640 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. The control panel shall be capable of expansion via up to 2 SLC modules. Each module shall support a maximum of 318 analog/addressable devices for a maximum system capacity of 636 points.
- C. 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 UCDH or Contractor.
- D. In conjunction with intelligent Loop Control Modules and Loop Expander Modules, the main FIRE ALARM CONTROL PANEL 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 display the location of the alarm condition on the FIRE ALARM CONTROL PANEL and all system annunciators. 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 all Notification Appliance Circuits.
 4. Visually and audibly annunciate any trouble, supervisory, security or alarm condition on operator's terminals, panel display, and annunciators.
- E. When a fire alarm condition is detected and reported by one of the fire alarm initiating devices, the following functions shall immediately occur:
 1. The system alarm LED shall flash.
 2. A local piezo-electric audible device in the control panel shall sound a distinctive signal.
 3. 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.
 4. Printing and history storage equipment shall log and print the event information including with a time and date stamp.

5. All system outputs assigned via preprogrammed equations for a particular point in alarm shall be executed, and the associated system outputs (i.e. alarm notification appliances and/or relays, etc.) 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:
1. The system trouble LED shall flash.
 2. A local piezo-electric audible device in the control panel shall sound a distinctive signal.
 3. 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.
 4. Printing and history storage equipment shall log and print the event information along with a time and date stamp.
 5. 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.
- G. When a supervisory condition is detected and reported by one of the system initiating devices or appliances, the following functions shall immediately occur:
1. The system trouble LED shall flash.
 2. A local piezo-electric audible device in the control panel shall sound a distinctive signal.
 3. The 640-character backlit LCD display shall indicate all information associated with the supervisory condition, including the type of trouble point and its location within the protected premises.
 4. Printing and history storage equipment shall log and print the event information along with a time and date stamp.
 5. All system outputs assigned via preprogrammed equations for the particular active point shall be executed, and the associated system outputs (notification appliances and/or relays) shall be activated.
- H. When a pre-alarm condition is detected and reported by one of the system initiating devices or appliances, the following functions shall immediately occur:
1. The system pre-alarm LED shall flash.
 2. A local piezo-electric audible device in the control panel shall sound a distinctive signal.
 3. 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.
 4. Printing and history storage equipment shall log and print the event information along with a time and date stamp.

2.6 NOTIFICATION APPLIANCE CIRCUIT POWER SUPPLY

- A. Notifier FCPS-24S8

2.7 SPARE PARTS

- A. Provide and turn over to the University the following equipment. Provide documentation confirming the equipment has been received.
 - 1. Five (5) of each type of automatic initiating device (smoke detector, heat detector, etc.) used including smoke detector mounting bases.
 - 2. Two (2) Manual Pull Stations
 - 3. One of each type of annunciating device (strobe, chime or other device).
 - 4. One (1) CPS module, one (1) LEM module, and one (1) LCM module for each control panel and DGP location.
 - 5. One power supply- ACPS-610(E) or latest version

PART 3 - EXECUTION

3.1 GENERAL

- A. The fire alarm system installation shall conform to Article 760 of the California Electrical Code.
- B. Installation of the fire alarm system shall not be started until detailed shop drawings and system specifications, including current California State Fire Marshal listing sheets for each component of the fire alarm system, have been approved by the California State Fire Marshal, the University Fire Department and the University Plant Operations and Maintenance department.

3.2 PREPARATION

- A. Review fire alarm print, device locations.
- B. A set of approved fire alarm shop drawings stamped by a University engineer of record shall be on the job site and used for installation. Any deviation from approved shop drawings, including substitution of devices are required to be reviewed and approved by the California State Fire Marshal and UCDH prior to installation.
- C. Coordinate with UCDH to determine campus wide non-overlapping fire alarm network node numbers.
- D. Coordinate with UCDH to determine fire alarm loop expansion availability.
- E. Coordinate with UCDH to determine software zone labeling.
- F. Provide preliminary shop drawings indicating zone labels and intended labeling to UCDH.
- G. Confirm firewall physical locations match design documentation.
- H. Coordinate with construction management for implementation.
- I. Coordinate access and materials delivery with University Representative.
- J. Use best practices for the demolition or replacement of existing equipment noted for demolition or replacement on the bid documents in remodeled areas.

- K. Maintain fire alarm operation during construction during tenant improvement work.
- L. Coordinate with UCDH for all fire alarm shutdowns.
- M. Coordinate with construction management for system initiation and start up.

3.3 INSTALLATION

- 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.
- B. Any discrepancies between the shop drawings and the code or recognized standards shall be brought to the attention of UCDH via the RFI process.
- C. A set of approved fire alarm shop drawings stamped by an engineer of record shall be on the job site and used for installation. Any deviation from approved shop drawings, including substitution of devices, be reviewed and approved by the California State Fire Marshal and UCDH prior to installation.
- D. Conduit shall be ¾" (19.1 mm) minimum.
- E. Install all wiring in accordance with NFPA 72, and all state and local codes .
- F. Color code for wiring devices shall be the following:
 - 1. 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.
 - 2. Addressable SLC loop - red & black twisted pair (2) Two #18-gauge West Penn 980 or equal.
 - 3. Annunciator data loop - red & black twisted shielded pair (2) Two #18-gauge West Penn 975 or equal.
 - 4. Visual circuit - red & black (2) Two #12-gauge THHN/THWN stranded.
 - 5. Annunciator power - purple and black (2) Two #14-gauge THHN/THWN stranded.
 - 6. Patient room light power - blue & black (2) Two #14-gauge THHN/THWN stranded.
 - 7. Door holder power - orange and black (2) Two #14-gauge THHN/THWN stranded.
 - 8. Fire fighters phone - red & black shielded (2) Two #18 West Penn 975 or equal.
 - 9. Speaker circuit - red & black (2) Two #16 West Penn 990 or equal.
 - 10. Remote test station - black, red & white 2#16 THHN/THWN stranded.
- G. 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 UCDH to UCDH Fire Dispatch and UCDH monitoring points.
- H. All field and Fire Alarm Control Panel wiring shall be terminated within terminal cabinets or on field devices. All components shall be made on terminals. Circuit completions shall be accomplished with cross-connect jumpers.

- I. Make all fire alarm wiring continuous from terminals to terminal or from terminal to device. All alarm initiation devices are to be wired without parallel branches (T tapping) and are to start and return at the main terminal cabinet.
- J. Spare conductors are to be provided on a 10% (minimum two conductor) schedule per riser, plus a minimum of six (6) spare conductors.
- K. Circuit splices not permitted:
 - 1. Wiring joints, only when required at devices shall utilize terminal strips. The use of wire nuts, crimp connector and similar shall not be allowed.
 - 2. Stranded Wire shall be terminated under screw heads with a fork type terminal installed on the wire.
- L. Solid core copper wire is required for all cabling from 26 to 16-gauge wire in the fire alarm system.
- M. Stranded core cabling shall be used for all wire that requires a gauge of 14 and over.
- N. Install all wiring in rigid, intermediate or electrical metallic conduit, minimum conduit size is $\frac{3}{4}$ ". 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.
- O. 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 liquid tight 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.
- P. 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.
- Q. Detectors shall be installed and located in accordance with the manufacturer's written instructions and the UL listing requirements.
- R. All fire alarm monitoring modules or dual modules such as form C relay module for dampers, tamper modules, water flow modules and switch modules shall be mounted in an accessible location below the ceiling in workspaces. Coordinate with UCDH for clarification.
- S. For new system installations - Provide a $\frac{3}{4}$ " conduit with a pull string from FIRE ALARM CONTROL PANEL to the IDF.
- T. All fire alarm wiring shall be in metal conduit, with any shielded wire connected to an earth ground at the control panel.
- U. For new systems - Where FIRE ALARM CONTROL PANELS and termination cabinets are mounted flush to finished wall or in areas where the finished ceiling is solid, install two (2) empty $\frac{3}{4}$ " conduits from the FIRE ALARM CONTROL PANEL to the attic area above in an accessible area. Terminate each of them in a separate 4-11/16" box in an accessible area.
- V. Cover all smoke detector devices during construction. Contractor shall replace all contaminated smoke detectors at no additional cost to UCDH.

- W. The fire alarm designer shall be responsible to determine the quantity and location of audible devices that will provide the required sound pressure levels as required by NFPA 72.
- X. 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 FIRE ALARM CONTROL PANEL and the main terminal cabinet shall be grounded via the bus bar.
- Y. 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.

3.4 FUNCTIONALITY

- A. The FIRE ALARM CONTROL PANEL shall be able to provide the following software and hardware features:
 - 1. 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.
 - 2. 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.
 - 3. 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.
 - 4. 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.
 - 5. The system shall support a detector response time to meet world annunciation requirements of less than 3 seconds.
 - 6. Device Blink Control: Means shall be provided to turn off detector/module LED strobes for special areas.
 - 7. NFPA 72 Smoke Detector Sensitivity Test: The system shall provide an automatic smoke detector test function that meet the requirements of NFPA 72.
 - 8. 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.
 - 9. 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.
 - 10. 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.

11. 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.
12. 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.
13. 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.
14. 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.
15. Two Wire Detection: The system shall support standard two wire detection devices specifically all models of System Sensor devices, Fenwal PDS-7125/7126 and CPD-7021, Hochiki model SLK-24F/24FH, Edwards 6250B/6270B and 6264B and Simplex models 2098-9201/9202 and 9576.
16. Block Acknowledge: The system shall support a block Acknowledge for Trouble Conditions.
17. Sensitivity Adjust: The system shall provide Automatic Detector Sensitivity Adjust based on Occupancy schedules including a Holiday list of up to 15 days.
18. 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.
19. 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.
20. 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 broad cast 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, pre-alarms, disabled points and activated points, all installed points filtered by SLC points, logic zones, annunciators, releasing zones, special zones, and trouble zones.
21. 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.

22. 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.
23. 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.
24. Custom Graphics: When fitted with an LCD display, the panel shall permit uploading of a custom bit-mapped graphic to the display screen.
25. 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.
26. Tracking/Latching Duct (ion and photo): The system shall support both tracking and latching duct detectors either ion or photo types.
27. 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.
28. 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 LDC. Activation of a NON-FIRE point shall activate control by event logic but shall not cause any indication on the control panel.
29. Security Monitor Points: The system shall provide means to monitor any point as a type security.
30. 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.
31. 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.
32. 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.

33. 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.
34. 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.
35. 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.
36. 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.
37. 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.
38. 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.
39. The FIRE ALARM CONTROL PANEL shall supervise all circuits to intelligent devices, transponders, annunciators and peripheral equipment and annunciate 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.
40. Sprinkler system valves, standpipe control valves, PIV, and main gate valves shall be supervised for off-normal position.
41. 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).

3.5 CENTRAL PROCESSING UNIT

- A. 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.
- B. The Central Processing Unit shall contain and execute all control-by-event (including Boolean functions including but not limited to AND, OR, NOT, ANY, and CROSSZONE) programs for

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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.

- C. 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.
- D. 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.
- E. Consistent with UL864 standards, the CPU and associated equipment are to be protected so that voltage surges or line transients will not affect them.
- F. 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.
- G. The CPU shall provide an EIA-232 interface between the fire alarm control panel and the UL Listed Electronic Data Processing (EDP) peripherals.
- H. The CPU shall provide two EIA-485 ports for the serial connection to annunciation and control subsystem components.
- I. The EIA-232 serial output circuit shall be optically isolated to assure protection from earth ground.
- J. The CPU shall provide one high-speed serial connection for support of network communication modules.
- K. 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.
- L. Transponders that lose communication with the CPU shall sound an audible trouble and light an LED indicating loss of communications.

3.6 DISPLAY

- A. 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.
- B. The display assembly shall contain, and display as required, custom alphanumeric labels for all intelligent detectors, addressable modules, and software zones.
- C. 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.

- D. 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.
- E. 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.

3.7 LOOP (SIGNALING LINE CIRCUIT) CONTROL MODULE

- A. 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.
- B. 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.
- C. 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.
- D. 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.
- E. 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.

3.8 FIELD WIRING TERMINAL BLOCKS

- A. 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.

3.9 CONTROLS WITH ASSOCIATED LED INDICATORS

- A. Speaker Switches/Indicators
 - 1. The speaker circuit control switches/indicators shall include visual indication of active and trouble status for each speaker circuit in the system.

2. The speaker circuit control panel shall include switches to manually activate or deactivate each speaker circuit in the system.

B. Emergency Two-Way Telephone Control Switches/Indicators

1. The emergency telephone circuit control panel shall include visual indication of active and trouble status for each telephone circuit in the system.
2. The telephone circuit control panel shall include switches to manually activate or deactivate each telephone circuit in the system.

3.10 REMOTE TRANSMISSIONS

- A. Provide local energy or polarity reversal or trip circuits as required.
- B. The system shall be capable of operating a polarity reversal or local energy or fire alarm transmitter for automatically transmitting fire information to the **UCDH Fire Department**.
- C. Provide capability and equipment for transmission of zone alarm and trouble signals to remote operator's terminals, system printers and annunciators.
- D. Transmitters shall be compatible with the systems and equipment they are connected to such as timing, operation and other required features.

3.11 FIELD PROGRAMMING

- A. 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.
- B. It shall be possible to program through the standard FIRE ALARM CONTROL PANEL keyboard all system functions.
- C. All field defined programs shall be stored in non-volatile memory.
- D. 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.
- E. 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 UCDH and building 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 operator upon his or her request.
- F. The installer's field programming and hardware shall be functionally tested on a computer against known parameters/norms which are established by the FIRE ALARM CONTROL PANEL 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.

3.12 SPECIFIC SYSTEM OPERATIONS

- A. 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.
- B. 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 any time after system turn-on. Alarm verification shall not require any additional hardware to be added to the control panel. The FIRE ALARM CONTROL PANEL 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.

3.13 EXECUTION

- A. General
 - 1. 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.
- B. Programming
 - 1. Provide all initial system programming, device types, zones, sensitivity etc.
 - 2. Provide University with a set of shop drawings, labeled software zones, 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.
- C. Fire Alarm Execution
 - 1. Elevation drawing that shows all fire alarm equipment enclosures and raceways on the wall where they will be installed. The highest operational portion of the fire alarm panels must not be mounted higher than 6 feet above finished floor. System status displays should be at 5"6" AFF.
 - 2. No equipment may be located under a cabinet containing batteries.
 - 3. 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.
 - 4. 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.

5. 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.
6. 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 FIRE ALARM CONTROL PANEL manufacturer.

D. Wire

1. All wire and cable shall be listed and/or approved by a recognized testing agency for use with a protective signaling system.
2. 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).
3. The system shall permit the use of IDC and NAC wiring in the same conduit with the multiplex communication loop.
4. All field wiring circuits 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.
5. All analog voice speaker and analog telephone circuits shall use twisted/shielded pair to eliminate cross talk.
6. Stranded wire only shall be used for all notification circuits.

E. Terminal Boxes, Junction Boxes and Cabinets

1. All boxes and cabinets shall be UL listed for their intended purpose.

F. Where used, initiating device 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.

G. 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 in accordance with the California Electrical Code.

H. Orient detectors with alarm indicator lights such that the indicator is visible from floor.

3.14 EXAMINATION / ACCEPTANCE / TESTING

- A. Thoroughly inspect and test installation with California State Fire Marshal for acceptance of device installation to verify conformance with manufacturer and specification tolerances. System acceptance testing shall include, but not be limited to, the following.
- B. Contractor shall, under this contract, obtain services of a factory trained representative of the fire alarm system manufacturer to provide testing to assure that system is in proper operating condition, and is in compliance with all applicable regulations. Contractor shall provide 4 sets of as-built drawings for mark-up during testing. 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 (UCDH

Fire Department) and a separate test shall be conducted for final acceptance by the California State Fire Marshal and OSHPD in the presence of the University's Representative, (UCDH Fire Department).

- C. Contractor shall demonstrate the following as part of the testing requirement for the fire alarm system:
1. System Point Operations: Any addressable device in the system shall have the capability to be enabled or disabled through the system keypad or display terminal.
 2. Validate Annunciator text messages and device addresses for each device shown.
 3. Validate separate software zone(s) disable(ing) for fire testing.
 4. Validate System output points shall be capable of being turned on or off from the system keypad or the display terminal.
 5. Validate the "Sequence of Operation" and Fire Alarm Program system shall be provided on CD in Microsoft Word format.
 6. Validate the system annunciates individual trouble or alarm conditions for each alarm initiation device in the building.
 7. Validate that not more than 75% of loop capacity on any loop. No more than 119 devices on any loop.
 8. Validate that no more than 7 loops in any multiplex panel. The remaining device and loop capacities shall be maintained as spare for future.
 9. Validate that the System Status Reports can be generated and printed.
 10. Validate 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.
 11. Test using actual power outage that the history buffer is retained by providing system reports following event.
 12. All failures shall be corrected and re-tested at Contractor expense.
- D. Point Read: Contractor shall demonstrate that the fire alarm system is able to display the following point status diagnostic functions without the need for additional equipment. Each point shall be annunciated for the parameters listed:
1. Device Status.
 2. Device Type.
 3. Custom Device Label.
 4. Software zone Label.
 5. Device zone Assignments.
 6. Analog Detector Sensitivity.
- E. Provide and turn over to the University the following spare equipment:
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).
- F. 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 hardcopy shop drawings shall be neatly folded in. It shall include manufacturer's 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, all software zone information (i.e. general alarm ZL230, Z230 etc.) 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.
- G. Using the fire alarm system as-built drawings and field redlines of 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 hardcopy plots. These Record 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 1, General Requirements – Closeout Procedures and Closeout Submittals).
- H. 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 system and component technical 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 FIRE ALARM CONTROL PANEL.
 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. Verify all general alarm zones work effectively when bypassed.
 11. 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 FIRE ALARM CONTROL PANEL and the correct activation of the control points.
 12. 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.
 13. Confirm offsite signal transmission and receipt at the central station and UCDH monitoring facility.

- I. Ground tests shall meet requirements of Part 3, Title 24, CEC.
- J. 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.
- K. 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.
- L. Perform initial fire alarm bypassing, zone separation, dampers, audibles, and door holders etc. validating the functionality of the system.

END OF SECTION