UC Davis Health

ACC NetV2 Upgrade

9559430

OFFICE OF THE STATE FIRE MARSHAL
APPROVED FIRE AND PANIC ONLY
Stephen Guarino
Stephen Guarino for
Kristi Mirich, Lead DCFM
09/14/2022 2:43:26 PM
Approval of this plan does not authorize or approve any omission or deviation from applicable regulations. Final approval is subject to field inspection. One set of approved plans shall be available on the project site at all times.

Project Manual

APPROVED
UC DAVIS HEALTH
BUILDING DEPARTMENT
REVIEWED FOR CODE COMPLIANCE

Paul R. Menard, AIA 09/20/2022 7:33:11 AM

The set of plans and specifications must be kept on the job site at all times and it is unlawful to make any changes or alterations to the approved set without written permission from the Building Department.

The approval of this plan and specifications SHALL NOT be held to permit or approve the violation of any University Policy or State Building Code.

This approval includes 500 pages.

HGA

Hammel, Green and Abrahamson, Inc.
1200 R Street, Suite 100
Sacramento, California 95811
(916) 787-5100

HGA Commission Number
1500-155-000

June 21, 2022

DOCUMENT 000105
CERTIFICATIONS PAGE

ARCHITECTURAL

STRUCTURAL

MECHANICAL

ELECTRICAL

END OF DOCUMENT

SECTION 011100
SUMMARY OF WORK

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Description of the Work

B. Contractor Warrants

C. Contract Document Intent and Relationships

D. University Furnished / Contractor Installed Products

E. Concurrent Work Under Separate Contracts

F. Site Condition Survey and Protection of Existing Improvements

G. Contractor Use of Site and Premises

H. University Beneficial Occupancy (if applicable)

I. Project Phasing (if applicable)

1.02 DESCRIPTION OF THE WORK

A. Project is titled: ACC NET V2 UPGRADE

B. UCDH Project No.: 9559430

C. Project is located at 4826 Y Street, Sacramento, CA 95817 University of California, Davis Medical Center, Sacramento, California, as shown on the vicinity map sheet G000.

D. Project Summary:

1. Building will be occupied and work to take place within hallways, office space, exam rooms, imaging space, and engineering space.

2. Project is to upgrade telecommunication rooms and fiber optic backbone cable to support future 10Gbps bandwidth.

E. A description of areas, types of construction, and general nature of the Work are described on drawing G000.

1. It is anticipated that after-hours work will be required in areas where patients or visitors are located.

F. Build-out as shown and herein specified, complete and ready for occupancy, the following is a renovation of the Technology Infrastructure shown on the Contract Documents.

1. Work is intended to be sequenced. General Contractor will work with UCDH to determine the logical method for the workflow to be performed.

1.03 CONTRACTOR WARRANTS

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

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

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

1.04 CONTRACT DOCUMENT INTENT AND RELATIONSHIPS

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

B. Relationship of Contract Documents: Drawings, Specifications, and other Contract Documents in the Contract is 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 27 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 the design discipline. Such organization and all references to trades, subcontractors, specialty contractors, or suppliers 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 a 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 the 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 Divisions 1 through 27 of the Contract.

1.05 UNIVERSITY-FURNISHED, CONTRACTOR-INSTALLED PRODUCTS

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

B. Relationship to Work Under the Contract: Work under the Contract shall include all provisions necessary to fully incorporate such products into the Work, including, as necessary, fasteners, backing, supports, piping, conduit, conductors, and other such provisions from point of service to point of connection, and field finishing, as shown on the Drawings and/or Specified herein. See Section 013100 - COORDINATION for additional requirements.

1.06 CONCURRENT WORK UNDER SEPARATE CONTRACTS

A. 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.

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

1.07 SITE CONDITION SURVEY & PROTECTION OF EXISTING IMPROVEMENTS

A. Site Condition Survey: Prior to commencing work, the Contractor, University Representative, and other University representatives shall tour the Project site together to examine and record the existing condition of the site, adjacent buildings, and improvements. This record shall serve as a basis for the 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 the Contractor causes excessive time and effort for University, University reserves the right to back charge the Contractor for additional work.

D. Sequencing of work will be required. Refer to construction documents/plans for specific requirements. At minimum:

1. Coordination with departments to determine working hours. Hours could include outside normal working hours.

2. Determine sensitive areas such as lab work.

3. ICRA compliance.

4. Removal of ceiling tiles.

1.08 CONTRACTOR USE OF SITE AND PREMISES

A. Site Access: Limit access to the 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 PM to 5:00 AM, Monday through Friday. Prior University approval is required for Contractor construction

work at any other time or day.

C. After-hours work will be required in areas where patients or visitors are located. These areas will be identified when the base project schedule is developed.

D. 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 Section 01510 - TEMPORARY UTILITIES for additional requirements.

E. 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's normal business operations and aligned with current sequencing. Provide fourteen (14) days' notice of all utility outages and shutdowns.

PART 2 - PRODUCTS – Not Applicable to this Section

PART 3 - EXECUTION

3.01 CONTRACTOR EXECUTION OF PROJECT

A. Contractor to coordinate working hours and phasing plan of work with UCDH personnel prior to the start of any work.

END OF SECTION 01 11 00

SECTION 012200
ALLOWANCES

PART 1 GENERAL

1.01 GENERAL

A. The Contract Lump Sum Base Bid as entered in Article 4.0 of the Bid Form shall include the amounts for all Allowances required in this section and elsewhere in the Contract Documents. All Allowances shall be provided by the Contractor for the amounts indicated.

B. The following shall apply to the Allowances, unless otherwise indicated in the Contract Documents:

1. Allowance amounts shall be for the full amount of compensation, both direct and indirect, and contain all overhead costs including but not limited to supervision, support, taxes, bonds, insurance, and profit.

2. Allowances shall be for complete compensation to the Contractor for all materials and equipment delivered at the Project site, including all overhead, taxes, insurance, shipping, and handling.

3. Allowances shall be for complete compensation to the Contractor for all labor amounts and shall include all overhead, supervision, support, tools and equipment to perform the work directed by the University's Representative.

4. Allowances for tradesmen in labor amounts will be utilized and directed by the University's Representative. These amounts are for work not included in the scope of the contract documents and are solely for the use and direction by the University's Representative

5. Upon project closeout, adjustments for any remaining quantities of the amounts included in the Allowances will be deleted from the contract sum on a per unit basis.

C. Contractor shall provide an allowance of $10,000.00 to include asbestos containment in the event asbestos is found in the building.

PART 2- PRODUCTS – NOT USED

PART 3 – EXECUTION – NOT USED

END OF SECTION 01 22 00

SECTION 012300
ALTERNATES

PART 1 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 - 27 of the Specifications for technical descriptions of the Alternates.

E. Coordinate related Work and modify surrounding Work as required to properly and completely integrate Alternates into the Work.

1.02 DESCRIPTION OF ALTERNATES

A. Provide cost to install 75 additional data cables including attachments.

1. General Cable GenSpeed 6A Part No.7141877 Purple.

2. Panduit- Mini-Com Faceplates (CFP (2,4,6) SY I CFP (4,8,10) S-2GY.

3. Patch Panel- Panduit CP48WSBLY

4. Testing and Labeling.

B. Refer to plans and Division specifications for alternates.

PART 2 - PRODUCTS – Not Applicable to this Section

PART 3 - EXECUTION – Not applicable to this Section

END OF SECTION 01 23 00

SECTION 012500
CLARIFICATION/INFORMATION PROCEDURES

PART 1 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 01610 – PRODUCT REQUIREMENTS: Product options, substitutions, omissions and improper descriptions.

1.03 ADMINISTRATIVE REQUIREMENTS

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

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

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

1.04 RFI PROCEDURES

A. RFI Format, Numbering and Subject:

1. RFI Format: Submit all requests for clarification or additional information in writing to University's Representative using the RFI Request for Information form provided at the back of this Section or obtained from University's Representative.

2. RFI Numbering: Number RFI's sequentially. Follow RFI number with sequential alphabetical suffix for resubmissions. For example, the first RFI is numbered "001". The second RFI is numbered "002" and so on. The first resubmittal of RFI "002" will be numbered "002a".

3. RFI Subject: Limit each RFI to one (1) subject only.

A. 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 2 - PRODUCTS – Not Applicable to this Section

PART 3 - EXECUTION

3.01 **EXECUTION OF RFI's**

A. Faxed RFI requests will be accepted. University's Representative's fax number is 916-734-7751. Notification time begins from date stamp of University's fax machine. Faxed RFI requests received after normal business hours and/or received on non-normal workdays, as defined in Specification Section 01310 – COORDINATION, Item 1.07.F.4.A will begin notification time starting at 7:00 AM the following business day.

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

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

2. Contractor submits the RFI as a Submittal.

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

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

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

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

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

2. After submission of an RFI by Contractor and prior to receipt of the RFI response

from University, the Contractor proceeds with effected Work at own risk. Any portion of the Work not constructed in accordance with University interpretation, clarification, instruction or decision is subject to removal and replacement at Contractor expense.

D. Failure to Agree: In the event of failure to agree to the scope of the Contract requirements, Contractor shall follow procedures set forth in Article 4 of the General Conditions of the Contract.

END OF SECTION 01 25 00

REQUEST FOR INFORMATION

A/C #: _____ **Project Title:** _____

RFI #: _____ **Date:** _____ **#:** _____

University of California, Davis, Medical Center Facilities Design & Construction 4800 2nd Avenue, Suite 3010, Sacramento, CA 95817 **Attn.: Ken Pickett** P: 916-734-4436 C: 916-934-8408 Email: kpickett@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 UCDH FD&C PROJECT MANAGER IN ACCORDANCE WITH THE CONTRACT DOCUMENTS.

COPIES: ☐ **UCDH** ☐ **CONSULTANTS** ☐ _____ ☐ _____ ☐ _____ ☐ **FILE**

SECTION 012550
CONTRACT MODIFICATION PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Change Order Administrative Requirements

B. Documentation of Change in Contract Sum and Contract Time

C. Change Procedures

D. Field Orders

E. Stipulated Sum Change Orders

F. Unit Price Change Orders

G. Time and Material Change Orders

H. Execution of Change Orders

I. Reconciliation of Change Orders

1.02 RELATED DOCUMENT SECTIONS

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 CHANGE ORDER ADMINISTRATIVE REQUIREMENTS

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

B. Forms found in the Exhibits of the Contract:

1. COST PROPOSAL Form

2. SUPPORTING DOCUMENTATION FOR THE COST PROPOSAL SUMMARY Form

3. CHANGE ORDER Form

4. REPORT OF SUBCONTRACTOR INFORMATION Form

1.04 DOCUMENTATION OF CHANGE IN CONTRACT SUM AND CONTRACT TIME

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

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

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

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

1. Quantities of products, labor and equipment.

2. Taxes, insurance and bonds.

3. Overhead and profit.

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

5. Credit for deletions from Contract, similarly documented.

1.05 CHANGE PROCEDURES

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

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

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

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

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

1. Include statement describing reason for change, and full description of effects on Contract Sum, Contract Time, related Work and work being performed under separate contracts.

2. Requests for substitutions shall be included under this category, with procedures as specified in Section 01610 – PRODUCT REQUIREMENTS.

1.06 FIELD ORDER

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

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

2. Promptly execute the change in the Work.

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

1.07 CHANGE ORDERS

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

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

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

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

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

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

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

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

PART 2 - PRODUCTS – Not Applicable to this Section

PART 3 - EXECUTION

3.01 EXECUTION OF CHANGE ORDERS

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

3.02 RECONCILIATION OF CHANGE ORDERS

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

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

END OF SECTION 01 25 50

SECTION 012700
UNIT PRICES

PART 1 - GENERAL

1.01 DESCRIPTION

A. Unit price quotations are to be inserted in the appropriate spaces in the Bid Form for each unit price item of Work described herein.

B. Unit prices stated in the Agreement shall be used to complete adjustments of the Contract Sum for approved unit price items of Work. Such adjustments shall be made by Change Order.

C. Unit prices shall include all labor, materials, tools, and equipment, direct and indirect costs necessary to complete the item of Work and coordinate the Work and shall include all overhead and profit. Contractor shall accept compensation computed in accordance with the unit prices as full compensation for furnishing such Work.

D. Compensation will be paid for those items of Work described below in sub-Section 2.01.

1.02 SPECIFIED WORK

A. Applicable Sections of the Specifications describe the materials and methods required for the various unit price items of Work.

PART 2 - PRODUCTS

2.01 UNIT PRICES

A. Refer to bid form for unit pricing items.

PART 3 - EXECUTION

3.01 UNIT PRICES

A. Immediately notify University's Representative when conditions require use of unit price items. {1, 2, 3, etc.}.

B. The applicability of, measurement methods for, documentation of, and final adjustment of, the Contract sum for unit price items of Work shall be determined by University's Representative.

C. After performing unit price items {1, 2, 3, etc.} as described by University's Representative, Contractor shall take necessary measurements in the presence of University's Representative and shall submit calculations of quantities to University's Representative for approval. Contractor shall notify University's Representative one (1) day in advance of taking measurements.

END OF SECTION 01 27 00

SECTION 012900
MEASUREMENT AND PAYMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

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

1.02 RELATED DOCUMENTS AND SECTIONS

A. GENERAL CONDITIONS of the Contract: Progress Payments and Final Payment.

B. Section 01320 – CONTRACT SCHEDULES

C. Section 01770 – CLOSEOUT PROCEDURES

1.03 PAYMENT APPLICATION FORM

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

1.04 PREPARATION OF APPLICATIONS

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

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

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

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

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

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

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

   d. Coordinate listings with Progress Schedule.

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

f. For items on which payments will be requested for stored products. List sub-values for cost of stored products with taxes paid.

g. Submit a sub-schedule for each separate Phase of Work specified in Section 01110 – SUMMARY OF THE WORK. Include scheduling of sequences for Phase of the Work as indicated in the Contract Documents.

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

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

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

B. Final Payment: Prepare Application for Final Payment as specified in Section 01770 – CLOSEOUT PROCEDURES.

1.05 SUBMISSION OF APPLICATIONS FOR PAYMENT

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

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

2. Submit an updated Construction Progress Schedule with each Application for Payment and specified in Section 01320 – CONTRACT SCHEDULES.

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

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

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

c. Coordinate listings with Progress schedule.

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

e. For items on which payments will be requested for stored products, list sub-values for cost of stored products with taxes paid.

f. Submit a sub-schedule for each separate Phase of Work specified in Section 01110. Include scheduling of sequences within each phase indicated on the drawings.

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

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

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

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

1.06 SUBSTANTIATING DATA

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

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

PART 2 - PRODUCTS – Not Applicable to this Section

PART 3 - EXECUTION – Not Applicable to this Section

END OF SECTION 01 29 00

SECTION 013100
COORDINATION

PART 1 - 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 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: Record Drawings.

1.03 MEETINGS

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

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

a. Special Project Procedures: Implementation of requirements as specified in Section 01310 – COORDINATION.

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

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

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

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

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

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

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

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

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

k. Materials and Equipment: Review substitution requirements; review schedule for major equipment purchases and deliveries; review materials and equipment to be provided by University (UFCI products).

l. Site Access by University's Representative and University's Consultants: Review requirements and administrative procedures Contractor may institute for identification and reporting purposes.

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

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

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

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

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

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

a. Suggested Agenda for Progress Meetings:

1) Building Code/Fire Marshal Issues

2) Design Issues

3) Submittals and Long Lead Items

4) Request for Information

5) Safety Issues

6) Scheduling Status/2 Week Look Ahead

7) Inspection Requests

8) Utility Shutdowns and Dig Notifications

9) Instructional Bulletins and Field Orders

10) Change Orders/Cost Proposals

11) Payment Applications and As-Built Drawings

12) Miscellaneous Business

13) Other items affecting progress of the Work

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

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

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 01330 – SHOP DRAWINGS, PRODUCT DATA AND SAMPLES, Section 01770 – CLOSEOUT PROCEDURES and Section 01780 – CLOSEOUT SUBMITTALS.

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

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

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

a. Fire Protection Drawings: Refer to Section 211313.

B. Coordination/Engineering Drawings: Submit in accordance with Section 01330 – 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 01770 – 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 45- calendar days to move University equipment and/or provide furnishings in work 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) days prior to desired digging activity.

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

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

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

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

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

F. The University does not normally charge for its shutdown support services. However, if poor planning and/or poor execution of a shutdown by the Contractor causes excessive time and effort for University personnel, 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 shutdown.

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

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

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

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

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

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

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

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

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

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

G. Utility locations: General location of utility lines and services may be shown on the drawings or described elsewhere, University does not warrant the accuracy of the locations shown or described. Determination of the actual on-site locations of utility lines and services prior to the commencement of work shall be the responsibility of the Contractor. Contractor shall complete layout/research for Points of Connection (P.O.C.) and clean/prep piping at P.O.C. All capping, relocation or removal of such lines and services shall be performed by Contractor as a part of the Contract. New/continued piping and services installation shall be prefabricated and in place prior to the shutdown. All materials and tools required to complete the work must be at the shutdown location(s).

Contractor shall not assume existing valves will hold 100%. Contractor is required to have at least one (1) alternate method (including parts and equipment) to complete installation once shutdown has started. Note: only wheel type cutters shall be used on copper pipe to reduce contamination to existing systems/valves.

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

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

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

3. Coordination/Engineering Drawings: These drawings are for the Contractor's and University's use during construction and shall not be construed as replacing any shop drawings, "as-builts", or record drawings required elsewhere in the Contract Documents. University's review of these drawings is for design intent only and shall not relieve the Contractor of the responsibility for coordination of all work performed per the requirements of the Contract.

   a. Contractor shall prepare and submit complete ¼" = 1' - 0" coordination drawings, including plans, sections, details as are appropriate indicating the area layout, complete with debris removal area and materials access points, and all mechanical and electrical equipment in all areas and within ceiling spaces for new and existing conditions, including bottom of all duct, plenum, pipe and conduit elevations. Drawings shall show all structural and architectural restraints and other obstructions that may affect the work. Electronic or photo reproduction of University's Architectural Drawings is not acceptable.

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

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

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

e. Completion of work: All coordination drawings shall be submitted together with record (as built) drawings of all trades involved in accordance with Section 01330 – SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.

PART 2 - PRODUCTS – Not Applicable to this Section

PART 3 - EXECUTION – Not Applicable to this Section

END OF SECTION 01 31 00

REQUEST FOR SHUTDOWN (RFS) INFO/IMPACT REPORT

PROJECT NAME: _____

UCDH RFS #: _____

PROJECT #: _____ **#:** _____ **CONTRACTOR RFS #:** _____

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

TO: UC DAVIS HEALTH **Facilities Design & Construction** **4800 2nd Avenue, Suite 3010** **Sacramento, CA 95817** **P: 916-734-4436** **F: 916-734-7751** **Attention: Ken Pickett**	**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 #: _____ #: _____ DATE: _____

TO: UC DAVIS HEALTH **Facilities Design & Construction** **4800 2nd Avenue, Suite 3010** **Sacramento, CA 95817** **P: 916-734-4436** **F: 916-734-7751** **Attention: Ken Pickett**	**FROM:** _____

1. Has USA been notified? YES ☐ NO ☐
   When? _____
2. Are all known utilities marked? YES ☐ NO ☐
3. Location of dig shown on attached site plan? YES ☐ NO ☐
   Purpose _____
4. Dates digging will take place _____
   Place _____

Signed: _____

UNIVERSITY USE ONLY

Date received: _____

1. Utilities verified by IOR? YES ☐ NO ☐
2. Dig activities coordinated with all parties? YES ☐ NO ☐
3. Comments: _____

Date Authorized: _____ Signed: _____

Date Returned: _____ Signed: _____

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

Copies: ☐ UCDH ☐ Consultants ☐ _____ ☐ _____ ☐ File

SECTION 013200
CONTRACT SCHEDULES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Construction Progress Schedules

B. Submittals Schedules

C. Review of Schedules and Submittals

D. Construction Progress Reports

1.02 RELATED DOCUMENTS AND SECTIONS

A. GENERAL CONDITIONS OF THE CONTRACT: Requirements to provide schedules.

B. Section 01110 – SUMMARY OF THE WORK: Subcontractor and materials suppliers list.

C. Section 01255 – CONTRACT MODIFICATION PROCEDURES: Supporting data.

D. Section 01290 – MEASUREMENT AND PAYMENT: Supporting data submittals.

E. Section 01310 – COORDINATION: Progress Meetings.

F. Section 1330 – SHOP DRAWINGS, PRODUCT DATA AND SAMPLES: Shop drawings, product data and samples submittals.

G. Section 01450 – QUALITY CONTROL: Test and Inspections Reports.

H. Section 01770 – CLOSEOUT PROCEDURES: Occupancy/Acceptance/Final Payment Submittals.

I. Section 01780 – CLOSEOUT SUBMITTALS: Preparation of maintenance and operating data.

1.03 CONSTRUCTION PROGRESS SCHEDULES

A. Schedule Format:

1. Prepare the Contract Schedules as Bar Charts showing continuous flow from left to right. Specific calendar dates shall be clearly and legibly shown for the start and finish of each Work activity.

2. Using opaque reproductions on substantial paper, with sheet size a multiple of 8-½" x 11" and large enough to clearly read characters. Prepare the schedule in sufficient detail to demonstrate adequate planning for the Work, and so that it represents a practical plan to complete the Work within the Contract time. Clearly indicate complete sequence of construction by major activity, including phasing with dates for beginning and completion of each element of Work.

3. Identify the following milestone events on the Contract Schedules:

a.	Submittal Reviews	i.	Fiber Backbone Testing
b.	Electrical rough-in and finish	j.	Punchlist
c.	UPS Work		
d.	HVAC rough-in and finish		
e.	Shutdowns		
f.	Telecommunication Room build-out		
g.	Fiber Backbone Installation		
h.	Fiber Backbone Termination		

4. Identify all holidays and non-working days on the Schedules.

5. Identify all Work activities that constitute the project critical path including:

   a. Major Contractor-furnished equipment, materials, and building elements, and scheduled activities requiring submittals or University's prior acceptance. Show dates for submissions, reviews, and acceptance of each submittal. Dates shall be shown for the procurement, fabrication, delivery, and installation of major equipment, material, and building elements, and for scheduled activities designated by University Representative.

   b. System test dates.

   c. Scheduled overtime Work if required by Contract Documents.

   d. Dates Contractor to request: designated working spaces, storage areas, access, and other facilities to be provided by University Representative; responses from University on designated issues; University-furnished equipment; University-furnished utilities.

   e. Dates for connection and relocation of existing utilities; dates for connections to or penetrations of existing structures.

   f. Scheduled inspections as required by Code, or as otherwise specified.

6. Critical path activities are defined as Work activities which, if delayed or extended, will delay or extend the scheduled completion of one (1) or more of the milestones specified in this Section or in the scheduled completion of the Work, or both. All other Work activities are defined as non-critical path Work activities and are considered to have associated float.

7. Float is defined as the time a non-critical Work activity can be delayed or extended without delaying the scheduled completion of milestones specified in this Section or the scheduled completion of Work, or both. Neither contractor nor University shall have exclusive right to the use of float. The entity using the float of any non-critical activity shall document the effect on the updated Contract Schedule.

8. Delays of non-critical Work activity shall not be the basis for an extension of Contract Time until the delays consume the float associated with the specific non-critical work activity and cause the Work to become critical.

9. Presentation of each Work activity on the Contract Schedule shall include a brief description of the Work activity, the duration of the Work activity in calendar days, and a responsibility code identifying the subcontractor, trade or vendor performing the Work activity.

10. Contractor shall furnish cost estimates for each Work activity that cumulatively equals the total contract cost. Mobilization costs may be shown separately; other costs, such as profit, and bond shall be pro-rated throughout all activities.

B. Updating:

1. Review Contract Schedule with University's Representative once each week to incorporate all changes in the progress, sequences, and scope of Works activities into the Contract Schedule. Contractor shall submit at each weekly progress meeting to University Representative, a two (2) week "look ahead" schedule in a bar chart format which incorporates all changes in progress, services, and scope of work activities.

2. Prepare and submit to University's Representative updated Contact Schedule once each month. Contractor shall submit the updated Contract Schedule, in the form acceptable to University, at least seven (7) days prior to submitting the Application for Payment.

3. Updated Contract Schedule shall accurately represent the as-built condition of completed and in-progress Work activities as of the date of the updated Contact Schedule.

4. Updated Contract Schedule shall incorporate all changes mutually agreed upon by Contractor and University during preceding periodic reviews and all changes from Change Orders and Field Orders. University will determine acceptability of updated Contract Schedule within seven (7) days of its receipt.

5. The Accepted, updated Contract Schedule shall be the Contract Schedule of record for the period it is current and shall be the basis of payment during that period.

1.04 SUBMISSIONS

A. Preliminary Contract Schedule: Submit a preliminary schedule to University's Representative either:

1. Within ten (10) days of receipt of the Notice of Selection as apparent lowest responsible bidder or, with the Agreement under separate transmittal letter.

2. Adjustments to Preliminary Contract Schedule: Within seven (7) days of receipt of the Preliminary Contract Schedule, University's representative will notify Contractor in writing of acceptance of Schedule, or submit to Contractor request for adjustments to Contract Schedule.

B. Contract Schedule: Submit the finalized Contract Schedule, in the form and having general content acceptable to University's Representative within fifteen (15) days following Notice to Proceed and prior to submitting the first Application for Payment. Submit monthly revised Contract Schedules thereafter, accompanying the Applications for Payment. Within seven (7) days of receipt of the Contract Schedule, University's Representative will notify Contractor in writing of acceptance of the revised Contract Schedule.

1. Payment Processing Restriction: No Application for Payment will be processed nor any progress payment become due until Contract Schedule is accepted by University.

2. Posting: Post one (1) copy minimum, of most recent Contract Schedule in the construction job site office, readily available to University and University's Representative.

3. Archive: Preserve a minimum of two (2) copies of all superceded schedules, with a minimum of one (1) copy available at job site office for review by University or University's Representative.

C. Submittals Schedule: Prepare Submittals Schedule in a format at Contractor's option, either bar chart, PERT, or GANTT format, using opaque reproductions on substantial paper, with sheet size a multiple of 8-½" x 11" and large enough to clearly read characters. Coordinate format with Contract Schedule, specified above.

1. Submittals Schedule Content: List all items specified to be submitted, indicating submittal number, submittal type (product data, shop drawings, samples, quality control report, maintenance and operating data, and other descriptions); scheduled data submittal shall be made and date review be complete in order to maintain construction schedule.

2. Administration: Submit initial Submittals Schedule within fourteen (14) days of date of Agreement. After review, resubmit Submittals Schedule within ten (10) days and thereafter submit updated Submittals Schedules at each Construction Progress Meeting. Submit one (1) copy each to University and University's Consultant. Posting/Archiving shall be same as Contract Schedule.

1.05 REVIEW OF SCHEDULES AND SUBMITTALS

A. University Representative and University's Consultant's Review of Schedules: Schedule review by University's Representative and University's Consultants shall be only for general conformance with the design concept of the Project and general compliance with the information given in the Contract Documents.

1. Review by University's Representative and University's Consultants shall not relieve the Contractor of compliance with requirements of the Contract Documents.

2. Changes in the Work shall not be authorized by submittals review actions.

3. No review action by University's Representative or University's Consultants, implicit or explicit, shall be interpreted to authorize changes in the Work. Changes shall only be authorized by separate written Change Order, in accordance with the General Conditions of the Contract.

B. University, University's Representative or University's consultants timely review of submittals and resubmittals.

1. University, University's Representative or University's Consultants shall have fourteen (14) calendar days to review all submittals and an additional fourteen (14) days of review of all resubmittals.

2. University, University's Representative or University's Consultant will prepare and keep log of review time of submittals.

PART 2 - PRODUCTS – Not Applicable to this Section

PART 3 - EXECUTION – Not Applicable to this Section

END OF SECTION 01 32 00

SECTION 013300
SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

PART 1 - 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 01110 – SUMMARY OF THE WORK: Subcontractor and materials suppliers list.

B. Section 01320 – CONTRACT SCHEDULES: Submission and review of schedules and submittals.

C. Section 01450 – QUALITY CONTROL: Test and Inspection Reports.

D. Section 01770 – CLOSEOUT PROCEDURES: Occupancy/Acceptance /Final Payment Submittals.

E. Section 01780 – CLOSEOUT SUBMITTALS: Preparation of Maintenance and Operating Data.

1.03 ADMINISTRATIVE REQUIREMENTS

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

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

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

a. The University’s Representative shall provide timely review of submittals and re-submittals.

1) University's Representative shall have fourteen (14) calendar days from receipt to review all submittals fourteen (14) calendar days from receipt to review re-submittals.

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

3. Substitutions shall be submitted in accordance with Section 01610 – PRODUCT REQUIREMENTS.

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

B. University's and University's Consultants Review: University's Consultant's review will be only for general conformance with the design intent of the Contract Documents. Review of submittals is not conducted for purpose of determining accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Contractor as required by the Contract Documents. Review actions of the University's Consultant or University shall not relieve Contractor from compliance with requirements of the Contract Documents. Changes shall only be authorized by separate written Change Order in accordance with the General Conditions of the Contract.

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

1.04 SUBMITTAL REQUIREMENTS

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

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

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

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

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

4. Include pertinent information such as performance characteristics and capacities, wiring or piping diagrams and controls, catalog numbers and similar data.

5. Modify manufacturer's standard schematic drawings and diagrams and other diagrams to delete information not applicable to the Work. Supplement standard information to provide information specifically applicable to the Work.

6. Identify changes from requirements of the Contract Documents.

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

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

C. Number of submittals required:

1. Product Data and Non-reproducible Submittals: Submit the number of copies Contractor will need, plus five (5) copies for University use.

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

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

4. Samples: Submit number specified. Samples shall be of sufficient size and quality to clearly illustrate the functional characteristics of the products, with integrally related parts and attachment devices, including full range of colors, textures and patterns.

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

1. 09250 – 1 First submittal for Section 09250 – Gypsum Board

2. 09250 – 2 Second submittal for Section 09250 – Gypsum Board

3. 09250 – 2A Re-submittal of second submittal for Section 09250 – Gypsum Board

4. 09250 – 2B Second re-submittal of second submittal for Section 09250 – Gypsum Board

E. Resubmission Requirements: Revise and resubmit as specified for initial submittal. Identify any Changes other than those requested. Note any departures from Contract Documents or changes in previously reviewed submittals.

F. Grouping of Submittals: Unless otherwise specifically permitted by University's Representative, make all submittals in groups containing all associated items as described in each Specification Section. The University's Representative will reject partial submittals as incomplete.

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

1.05 DISTRIBUTION

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

1. Contractor's Project site file.

2. Record Documents file maintained by Contractor.

3. Pertinent Separate Contractors.

4. Pertinent Subcontractors.

5. Pertinent Supplier or Manufacturer.

1.06 SUBMITTAL SCHEDULE

A. Submittals Schedule: refer to Section 01320 – CONTRACT SCHEDULES.

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

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

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

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

PART 2 - PRODUCTS – Not Applicable to this Section

PART 3 - EXECUTION – Not Applicable to this Section

END OF SECTION 01 33 00

SECTION 013400
CONTRACTOR(S) EMERGENCY PROCEDURES

PART 1 - GENERAL

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

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

PART 2 - DEFINITIONS

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

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

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

2.04 Code Red – Fire

2.05 Code White – Hazardous Material / Chemical Spill

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

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

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

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

A. Water system failure

B. Telephone system failure

C. Fire

D. Electrical system failure

E. Security

F. Chemical spill

G. Evacuation

PART 3 - PROCEDURES

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

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

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

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

1. Emergency Telephone Numbers

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

END OF SECTION 01 34 00

SECTION 013500
SPECIAL PROCEDURES

PART 1 - 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 01110 – SUMMARY OF THE WORK

C. Section 01310 – COORDINATION

D. Section 01320 – CONTRACT SCHEDULES

E. Section 01560 – TEMPORARY BARRIERS, ENCLOSURES AND CONTROLS

F. Section 01561 – AIRBORNE CONTAMINANTS CONTROL

G. Section 01730 – CUTTING AND PATCHING

H. Section 01740 – CLEANING

1.03 INTERIM LIFE SAFETY MEASURES (ILSM)

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

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

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

2. Contractor shall submit proposed Fire and Life safety impairments (21) days prior to implementation. Submittal of ILSM does not infer or guarantee acceptance by University. All submitted measures shall be reviewed and returned to Contractor indicating approval, approval as noted, or rejection, revision, or re-submittal requirement by University in writing no less than fourteen (15) calendar days

prior to proposed implementation. If re-submittal is required, twenty-one (21) day review period from date of re-submittal will be required.

C. Project ILSM Procedures: If a life safety code deficiency occurs, or is identified by any source, or the requirements of the current Life Safety Code are not being met; Interim Life Safety Measures must be implemented to the extent necessary to compensate for any deficient element(s) predicated on magnitude, severity, extent and duration before corrective actions are completed.

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

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

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

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

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

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

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

C. Personnel Identification: Provide identification card to each person authorized to enter premises, showing: Personal photograph, name and assigned number, expiration date, and employer. Maintain a list of accredited persons; submit copy to University's Representative on request.

D. Miscellaneous Restrictions: Do not allow cameras on site; do not allow photographs except with written approval of University.

1.05 HAZARDOUS MATERIALS PROCEDURES

A. Except as otherwise specified, should Contractor encounter site materials, reasonably believed to be asbestos, polychlorinated biphenyl (PCB), radioactive material, lead in paint, lead lining in walls or glass windows, lead in ceramic products, mold, water leaks or

other hazardous materials or conditions, the Contractor shall immediately stop work in the affected area and report the condition to University's Representative in writing. The work in the affected area shall not thereafter be resumed except by written agreement of University and Contractor if in fact the material is identified as hazardous and has not been rendered harmless. The work in the affected area shall be resumed in the absence of hazardous materials, or when such materials have been rendered harmless.

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

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

PART 2 - PRODUCTS – Not Applicable to this Section

PART 3 - EXECUTION – Not Applicable to this Section

END OF SECTION 01 35 00

SECTION 013900
GREEN BUILDING POLICY IMPLEMENTATION

PART 1 – 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 01560 – Temporary Barriers, Enclosures and Controls

B. Section 01561 – Airborne Contaminants Control

C. Section 01610 – Product Requirements

D. Section 01740 – Cleaning

E. Section 01750 – Starting and Adjusting Systems

F. Section 01760 – Protecting Installed Construction

G. Section 01770 – Closeout Procedures

H. Section 01780 – Closeout Submittals

I. Section 01810 – Plumbing/HVAC Testing Procedures

J. Section 01820 – Demonstration and Training

K. Section 02725 – Storm Drainage Water Quality

L. Section 14240 – Hydraulic Elevators

M. Section 14580 – Pneumatic Tube Systems

N. Division 22 – Mechanical Work (All)

O. Division 26 – Electrical Work (All)

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 are represented in the contract schedule.

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

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

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

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

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

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

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

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

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

1.04 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 UCDHS Sustainability Administrator on a monthly basis (information for June is due by July 20):

   a. Waste Management Log (Appendix B at the end of this Section):

   b. Project title, name of company completing report and dates of period covered by the report.

   c. Date, destination, and quantity of each type of material landfilled, salvaged or recycled.

   d. Weighmaster tickets can be substituted for items a and c (except for salvaged items). In all instances, weighmaster tickets must be provided with this submittal.

e. Alternative report formats may be acceptable, but must be reviewed and approved by the UCDHS Sustainability Administrator before being used in lieu of the requirements above.

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

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

D. PROJECT MEETINGS

1. Discuss Waste management plans and implementation at the following meetings:

a. Pre-construction meeting.

b. Regular job-site meetings.

E. PROJECT CONDITIONS

1. Hazardous materials are excluded from the work of this Section. If hazardous materials are encountered or suspected, stop work in the suspect area. Refer to Section 01350 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 start up date. SMACNA Guidelines for HVAC protection and for protection of absorptive materials may need to start at an earlier stage, in accordance with the construction schedule.

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

3. Comply with requirements of Section 15890 – Ductwork.

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

1. Comply with requirements of Section 15890 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 15890 – 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 spells or excess applications of solvent-containing products as soon as possible.

f. Also refer to Section 15890 – 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 Section 15890 – Ductwork for additional requirements. Monitoring of IAQ Plan

d. A minimum of 18 photographs, documenting the progress of the IAQ management Plan implementation, shall be taken at the following stages:

1. Site delivery and storage processes

2. Installation, protection, and housekeeping activities

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

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

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

5. Building Flush-Out

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

      1. Total days required and actual days conducted.

      2. Hours per day required actual hours conducted.

      3. Outside air percentage recommended and actual used.

PART 2 – PRODUCTS – NOT APPLICABLE TO THIS SECTION

PART 3 – EXECUTION – NOT APPLICABLE TO THIS SECTION

END OF SECTION 01 39 00

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

PROJECT TITLE: _____

COMPANY: _____

DATE: _____

		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 014100
REGULATORY REQUIREMENTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Relationship between Code, Ordinances, Standards and Contract Documents

B. Applicable Codes, Laws and Ordinances

C. Project Inspections

D. Office of Statewide Health Planning & Development Projects

1.02 RELATED SECTIONS

A. Section 01350 – SPECIAL PROCEDURES

B. Section 01420 – REFERENCES

C. Section 01450 – QUALITY CONTROL

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

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

B. Precedence:

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

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

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

1.04 APPLICABLE CODES, LAWS AND ORDINANCES

A. Building Codes:

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

a. 2019 California Administrative Code, California (CAC) Code of

Regulations – Title 24, Part 1

b. 2019 California Building Code, California (CBC) Code of Regulations – Title 24, Part 2, Volume 1

c. 2019 California Building Code, (CBC) California Code of Regulations – Title 24, Part 2, Volume 2

d. 2019 California Electrical Code, (CEC) California Code of Regulations – Title 24, Part 3

e. 2019 California Mechanical Code, (CMC) California Code of Regulations – Title 24, Part 4

f. 2019 California Plumbing Code, California Code of Regulations – Title 24, Part 5

g. 2019 California Energy Code, California Code of Regulations – Title 24, Part 6

h. 2019 California Fire Code, California Code of Regulations – Title 24, Part 9

i. 2019 California Existing Building Code, California Code of Regulations – Title 24, Part 10

j. 2019 California Referenced Standards Code, California Code of Regulations – Title 24, Part 12

k. 2019 NFPA 13 – Standard for the Installation of Sprinkler Systems

l. 2019 NFPA 14 – Standard for the Installation of Standpipe and Hose System

m. 2019 NFPA 72 – National Fire Alarm and Signaling Code

n. 2019 NFPA 80 – Standard for Fire Doors and Other Opening Protectives

o. 2019 NFPA 99 – Health Care Facilities Code

p. 2018 NFPA 101 – Life Safety Code

q. 2019 NFPA 252 – Standard Methods of Fire Tests of Door Assemblies

r. 2019 NFPA 701 – Standard Methods of Fire Tests of Flame Propagation of Textiles and Films

s. California Code of Regulations, Current Editions:

1) Title 8, Industrial Relations

2) Title 17, Public Health (Chapter 7)

3) Title 19, Public Safety

4) Title 21, Public Works

5) Title 22, Social Security

6) Title 24, Parts 1, 2, 3, 4, 5, 9 and 12

7) Title 25, Energy Insulation Standards

t. Americans with Disabilities Act (ADA) 2010

u. OSHPD code applications notices and policy intent notices

v. Rules and regulations of private and public utilities

w. American National Standards Institute (ANSI)

x. American Society of Testing Materials (ASTM)

y. Federal Specifications (Fed. Spec.)

z. Underwriters Laboratories

aa. National Fire Protection Association (NFPA) (as adopted by State agencies)

bb. Traffic controls per California MUTCD requirements

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

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

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

B. Other Applicable Laws, Ordinances and Regulations:

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

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

3. Where such laws, ordinances, rules and regulations require more care or greater

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

4. **GENERAL CONTRACTOR SHALL NOT SELF-PERFORM SPECIALTY CONTRACTING WORK DEFINED IN SECTIONS 7055 – 7059.1 OF THE CALIFORNIA BUSINESS AND PROFESSIONS CODE UNLESS THE GENERAL CONTRACTOR HAS THE SPECIALTY CONTRACTORS LICENSE APPROPRIATE FOR THE WORK PERFORMED. OTHERWISE, SPECIALTY CONTRACTORS SHALL BE RETAINED BY THE GENERAL CONTRACTOR TO PERFORM SPECIALTY WORK IDENTIFIED IN THE PROJECT SCOPE".**

1.05 PROJECT INSPECTIONS

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

1. Contractor shall allow inspectors full access to Project at all times.

2. Contractor shall not take any direction, approvals or disapprovals from inspectors.

3. Contractor shall not rely on inspectors to ensure Work is completed in accordance with Contract Documents.

4. Acts of omissions of any inspector (including without limitation inspector's failure to observe or report deficiencies in Contractor's Work) shall not relieve Contractor for responsibility to complete Work in accordance with Contract Documents.

1.06 DEFERRED APPROVAL

A. There is no deferred approvals as part of this project.

PART 2 - PRODUCTS – Not Applicable to this Section

PART 3 - EXECUTION – Not Applicable to this Section

END OF SECTION 01 41 00

SECTION 014200
REFERENCES

PART 1 - 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 01410 – REGULATORY REQUIREMENTS

1.03 DEFINITIONS OF TERMS

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

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

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

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

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

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

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

6. Directed: As instructed by University or University's Representative, in writing, regarding matters other than the means, methods, techniques, sequences and procedures of construction. Terms such as "directed", "requested", "authorized", "selected", approved", "required", and "permitted" mean "directed by University's Representative", requested by University's Consultant" or University's Representative and similar phrases. No implied meaning shall be interpreted to extend the University's Representative responsibility into Contractor's supervision of construction.

7. Equal or Equivalent: As determined by the University's Consultant as being of the same quality, appearance, utility, durability, finish, function, suitability, and performance.

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

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

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

11. Installer: "Installer" is the Contractor or an entity engaged by the Contractor, as an employee, subcontractor, or sub-subcontractor for performance of a particular construction activity, including installation, erection, application, and similar operations. Installers are required to be experienced in the operations they are engaged to perform.

    a. Experienced Installer: The term "experienced", when used with "installer" means having a minimum of five (5) previous Projects similar in size to this Project, and familiar with the precautions required, and with requirements of the authority having jurisdiction.

12. Jobsite: Same as site.

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

14. Noted: Same as indicated.

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

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

17. Products: Materials, systems or equipment.

18. Project site: Same as site.

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

20. Provide: Means "furnish and install, complete and ready for use".

21. Regulation: Includes laws, ordinances, statutes and lawful orders issued by authorities having jurisdiction, and rules, conventions and agreements within the construction industry that control performance of the Work, whether lawfully imposed by authorities having jurisdiction or not.

22. Required:

    a. As required by regulatory requirements of governing authorities.

    b. As required by referenced standards.

    c. As required by existing job conditions.

    d. As generally provided by accepted construction practices of the locale.

    e. As indicated on the Drawings and in the Specifications.

    f. As otherwise required by the Contract Documents.

23. Scheduled: Same as indicated.

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

25. Shown: Same as indicated.

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

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

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

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

1.04 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
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
OSHPD	Office of Statewide Health Planning and Development (State of California)
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 2 - PRODUCTS – Not Applicable to this Section

PART 3 - EXECUTION – Not Applicable to this Section

END OF SECTION 01 42 00

SECTION 014500
QUALITY CONTROL

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Contractor's Quality Control

B. Quality of the Work

C. Inspections and tests by governing authorities

D. Inspections and tests by serving utilities

E. Inspections and tests by manufacturer's representatives

F. Inspections and Independent testing and Inspection Laboratories/Agencies

G. Contractor responsibilities in inspections and tests

H. Contractor responsibilities regarding UCDH testing laboratory

I. Test reports

J. Geotechnical engineer

1.02 RELATED SECTIONS

A. Section 01310 – COORDINATION

B. Section 01410 – REGULATORY REQUIREMENTS: Compliance with applicable codes, ordinances and standards.

C. Section 01455 – INSPECTION OF WORK

D. Section 01610 – PRODUCT REQUIREMENTS: Product Options, substitutions, transportation and handling requirements, storage and protection requirements, and system completeness requirements.

1.03 CONTRACTOR'S QUALITY CONTROL

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

B. Quality Requirements: Work shall be accomplished in accordance with quality requirements of the Contract Documents, including, by reference, all Codes, laws, regulations and standards. When no quality basis is prescribed, the quality shall be in accordance with the best-accepted practices of the construction industry for the locale of the Project, for projects of this type.

C. Quality Control Personnel: Contractor shall employ and assign knowledgeable and skilled personnel as necessary to perform quality control functions to ensure the Work is provided as required.

1.04 QUALITY OF THE WORK

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

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

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

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

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

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

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

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

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

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

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

G. Observations by University's Consultants: Periodic and occasional observations of the Work in progress will be made by University's Consultant and their consultants as deemed necessary to review progress of Work and general conformance with design intent.

H. Limitations on Inspections, Tests and Observations: Neither employment of independent testing and inspection agencies nor observations by University's Consultant and their consultants shall relieve Contractor of obligation to perform Work in full conformance to all requirements of Contract Documents.

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

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

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

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

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

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

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

1.05 INSPECTIONS AND TESTS BY GOVERNING AUTHORITIES

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

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

1. Such authorities include University's Building Inspection (code compliance), University's Fire 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.

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.

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

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

List the applicable services required, for example:

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) copy of report shall be promptly submitted to University's Representative, Contractor and to agency having jurisdiction (if required by code).

1. Reports shall clearly identify the following:

   a. Date issued

   b. Project name and 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 01455 – INSPECTION OF WORK, Item 1.05, Scheduling Inspections – Notification Requirements.

B. If such procedures for testing, inspection or acceptance reveal failure of any portion of the Work to comply with requirements of the Contract Documents, Contractor shall bear all costs made necessary by such failure including those of repeated procedures, including compensation for University's Consultant's services and expenses.

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

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

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

1.10 CONTRACTOR RESPONSIBILITIES REGARDING UCDH TESTING LABORATORY

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

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

C. Submit copies of product test reports as specified.

1.11 TEST REPORTS

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

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

PART 2 - PRODUCTS – Not Applicable to this Section

PART 3 - EXECUTION – Not Applicable to this Section

END OF SECTION 01 45 00

SECTION 014510
SEISMIC CONTROL

PART 1 - GENERAL

1.01 DESCRIPTION

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

1.02 QUALITY ASSURANCE

A. ASTM standards

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.

PART 2 - 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.).

B. SEISMIC RESTRAINT DESIGN

1. The attachment, supports and seismic restraints of suspended non-structural components and distribution systems listed below shall be designed to resist the total design seismic forces prescribed in the CBC.

   a. All equipment/components including but not limited to: electrical, mechanical, plumbing, and architectural.

   b. Design and installation shall consider seismic relative displacement in accordance with ASCE 7-16.

2. Seismic restraint transverse and/or longitudinal spacing shall be in accordance with CBC 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.

   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. 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

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 approval of the Project Manager and verifying that the embedment depth will not damage any buried conduits or piping.

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.

D. 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 3 - EXECUTION

3.01 SEISMIC ANCHORING AND RESTRAINTS

A. Equipment anchors:

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

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

3. Anchor details provided are based on specific equipment information. Submit design for approval for anchoring of equipment which varies from design.

B. Conduit supports:

1. Conduits shall be supported and braced per CBC.

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.

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 014520
SEISMIC CONTROL – NON-OSPHD

PART 1 - GENERAL

1.01 DESCRIPTION

A. Provide all required seismic restraints and calculations in order to insure that the installation is 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.

PART 2 - PRODUCTS

2.01 SEISMIC RESTRAINT REQUIREMENTS

A. SUMMARY

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

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

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

B. SEISMIC RESTRAINT DESIGN

1. The attachment, supports and seismic restraints of suspended non-structural components and distribution systems listed below shall be designed to resist the total design seismic forces prescribed in the California Building Code (CBC).

a. All equipment/components including but not limited to: electrical, mechanical, plumbing, and architectural.

b. Attachment, supports and seismic restraints that are not shown on the approved construction document 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 designers of record and the University for acceptance prior to installation. Cost to be borne by the contractor.

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

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

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

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

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

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

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

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

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

b. Engineered details and engineering for all vertical supports and their connections to the building structure to qualify, that top connections

cannot develop moments, that lateral motion will not cause loss of item/system support, that lateral motion of the item/system will not cause damaging impact with other items/systems, that lateral motion of the item/system will not directly or indirectly impact any life safety, emergency services and/or hazardous items/systems or their supports.

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

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

6. Seismic restraint cables shall be looped through the seismic hardware bracket and turned back onto itself at the point of assembly/connection. Cables shall not be installed or attached to the seismic hardware bracket in a straight through (non-turn back) method of assembly/connection.

7. Seismic hardware brackets, connectors and related components shall be constructed entirely of malleable iron or steel. Seismic assemblies shall not include the use of cast components.

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

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

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

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

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

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

14. 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.

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

C. ANCHORS, INSERTS AND FASTENERS

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

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

   a. ICC evaluation report

   b. OSHPD pre-approved

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

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

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

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

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

D. FIELD QUALITY CONTROL

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

PART 3 - EXECUTION

3.01 SEISMIC ANCHORING AND RESTRAINTS

A. Equipment anchors:

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

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

3. Anchor details provided are based on specific equipment information. Submit design for approval for anchoring of equipment which varies from design.

B. Conduit supports:

1. Conduits shall be supported and braced per CBC Title 24.

C. Lighting fixture supports:

1. Provide independent seismic support system for all lighting fixtures.

D. Minimum Clearance:

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

3.02INSTALLATION AND TESTING OF MECHANICAL ANCHORS:

A. Where permitted in other Sections of this specification, 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, procedure, and acceptance criteria of post-installed anchors in concrete shall be in accordance with CBC 1901.3.4.

END OF SECTION 01 45 20

SECTION 014550
INSPECTION AND TESTING OF WORK

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Project Inspections and Procedures

B. Scheduling Inspectors – Notification requirements

1.02 RELATED SECTIONS

A. Section 01310 – COORDINATION

B. Section 01320 – CONTRACT SCHEDULES

C. Section 01350 – SPECIAL PROCEDURES

D. Section 01410 – REGULATORY REQUIREMENTS

E. Section 01450 – QUALITY CONTROL

1.03 DEFINITIONS

A. IOR: Inspector-of-Record

B. ACO: Area Compliance Officer for OSHPD

C. DSE: District Structural Engineer for OSHPD

D. FM: Fire Marshal (may include both OSHPD FM and State FM)

E. TL: Testing Laboratory

1.04 PROJECT INSPECTIONS AND TESTING PROCEDURES

A. Inspections: This Project is not under the jurisdiction of the Office of Statewide Health Planning and Development. The following inspections will be requested on this project, as appropriate. Also see Part 3 for non-OSHPD inspection items.

1. Inspections required by the California Building Code

2. 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 codes referred to in the approved plans must be maintained on the job at all times.

3. 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. OSHPD Field Compliance Inspectors: Fourteen (14) calendar days.

3. Testing Laboratory Inspections: Twenty-four (24) hours.

   a. All testing laboratory and testing procedures must be scheduled by University's Representative. Inspections and/or testing directly scheduled by Contractor will not be accepted.

   b. Contractor will bear all costs associated with unauthorized inspections and testing.

4. State Fire Marshal Inspection request Notification: Seventy-two (72) hours.

B. Methods of Inspection Notification:

1. All inspection notifications shall be in writing using inspection forms located at back of this Section. Incomplete forms will be returned as non-compliant and no inspection will be scheduled until all required inspection information is provided.

2. Faxed inspection requests will be accepted. University's Representative fax number is 916-734-1375 notification time begins from date stamp of University's fax machine. Faxed notification requests received after normal business hours and/or received on non-normal workdays, as defined in Specification Section 01310 – COORDINATION, paragraph 1.07.F.4.A will begin notification time starting at 7:00 AM the following normal business day.

3. Emailed inspection requests will be accepted. University's Representative email address is fdc.inspectors@ucdmc.ucdavis.edu. Notification time begins from the date and stamp of the email, provided it is sent during normal business hours. Emailed inspection requests sent after normal business hours and/or received on non-normal workdays, as defined in Specification Section 01310 – 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 2 - PRODUCTS – Not Applicable to this Section

PART 3 - EXECUTION

Note: Part 3 describes typical inspection requirements for each individual inspector's jurisdiction for non-OSHPD projects. Part 3 is provided as a reference source for Contractor's use and Scheduling, as applicable. Part 3 is not intended to be all-inclusive and Contractor shall verify actual inspection requirements needed for this project. See Item 3.12 for Testing, Inspection Observation for OSHPD.

3.01 FIRE DAMPERS (Title 24, Part 2, Chapter 43)

Note: Manufacturer's installation instructions shall be used for inspections and testing.

A. 1 Hour: IOR test 100%. State Fire Marshal tests 100% or as needed.

B. 2 Hour: IOR tests 100%. State Fire Marshal tests 100%.

C. Smoke: IOR tests 100%. State Fire Marshal tests 100%.

3.02 FIRE SPRINKLERS (Title 24, Part 2, Volume 1, Chapter 9; NFPA Bulletin 13)

A. Approved drawings shall be on job-site from start to completion of project.

B. Underground pressure test @ 200 psi.

C. State Fire Marshal to witness installation of underground lines.

D. State Fire Marshal to witness underground flush prior to connection.

E. Hydro-test above ground piping @ 200 psi for two (2) hours.

F. Inspection of hangers, bracing, and seismic joint crossing(s).

G. Flow alarm test, tamper switch test.

H. Fire pump test.

I. Certification by installer (Title 24, Part 9, Article 1006.3.4.2).

J. Final inspection: signs in place, labeling, fire extinguishing system flow alarm test.

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

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

A. Approved drawings shall be on job-site from start to completion of project.

B. Verify Emergency Power source.

C. Activate all initiating devices.

D. Certification by installer (Title 24, Part 9, Article 1006.3.4.2).

E. Complete test of system per Title 24, Part 9, CFC, Article 1003.3.4.1).

3.04 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 job-site 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 and Inspector-of-Record.

2. Electrical Engineer-of-Record acceptance of system.

3. Owner In-Service training on Equipment.

4. Equipment Manuals and Instruction to Owner.

5. Warrantees and Equipment Certification.

6. As-Built/Record Drawings to Owner.

3.10 FIRE MARSHAL INSPECTION REQUIREMENTS

A. Framing Inspections

1. Structural members in fire-resistive construction.

2. Check fireproofing per approved design tested assembly description.

B. Fire-Rated Partition Locations

1. Check for stud and nailing/screwing spacing per approved design tested assembly description.

2. Check for fire blocking in combustible construction.

3. Check for rated door/window frame installation (manufacturer's installation instructions shall be available for review).

4. Check for electrical installation, for example; number and size of electrical boxes, panels, cabinets, etc.

5. Check hangers, seismic bracing for sprinkler piping installation, if applicable (this would be checked during overload pressure test inspection phase of sprinkler system).

C. Close-In Inspections

1. Check fire-blocking and draft stops in combustible construction.

2. Check gypsum board installation in accordance with approved design assembly description for rated assembly.

3. Check integrity of firewall construction where recessed cabinets, panels, excessive electrical/plumbing are installed.

4. Check fire damper installation (manufacturer's installation instructions shall be available for review). Fire Marshal will witness actuation of minimum 10% fire dampers installed and 100% in 2 hour or greater fire rated wall assemblies.

5. Check for through-penetrations and fire-stop systems in all walls or floor/ceiling assemblies.

D. Final Construction Inspections

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

END OF SECTION 01 45 50

INSPECTION REQUEST

A/C #: _____ **OSHPD #:** _____ **UCDH IR #:** _____ **Contractor IR #:** _____ **Date:** _____

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

To: UC Davis Health (UCDH)	**From:**
Facilities Design & Construction – Inspection Trailer	
4430 V Street, Building 35	
Sacramento, CA 95817	
P: 916-734-5060	**P:**
F: 916-734-1375	**Email:**
Email: lfuka@ucdavis.edu & Project IOR	**Attn.:**

Drawing Ref.: _____ **Detail:** _____ **Shop Drawing:** _____

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

Type of Inspection: _____

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

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

All work Requested for Inspection has been reviewed for compliance with the contract documents by Contractor's Superintendent prior to notification of Inspection Request.

Signed: _____ **Date:** _____

UCDH 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

A/C #: _____ **OSHPD #:** _____ **Notice #:** _____ **Date:** _____

To: _____	**From: UC Davis Medical Center (UCDMC)**
_____	**Facilities Design & Construction – Inspection Trailer**
_____	**4430 V Street, Building 35-A**
_____	**Sacramento, CA 95817**
P: _____	**P: 916-734-5060**
Email: _____	**F: 916-734-1375**
Attn.:	**Email: fdc.inspectors@ucdmc.ucdavis.edu**

Spec Section Ref.: _____ **Paragraph:** _____ **Drawing Ref.:** _____

Detail: _____

In accordance with Article 12 of the General Conditions, the following defective condition(s) has/have become apparent:

Reported by: _____

CORRECTIVE ACTION SHOULD BE TAKEN AS SOON AS POSSIBLE AND COMMENCE NO LATER THAN TEN (10) CALENDAR DAYS AFTER THIS NOTICE. COORDINATE THE VERIFICATION OF THE CORRECTIVE ACTIONS WITH THE INSPECTOR OF RECORD. IF FURTHER INFORMATION IS NEEDED, ADVICE UNIVERSITY'S REPRESENTATIVE IN ACCORDANCE WITH THE GENERAL CONDITIONS.

Description of corrective action taken: _____

Accepted by: _____ **Date:** _____

CC:

SECTION 015100
TEMPORARY UTILITIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Temporary Power and Lighting.

B. Temporary Heating, Cooling & Ventilation.

C. Temporary Water.

D. Temporary Fire Protection.

E. Temporary Telephone.

1.02 RELATED SECTIONS

A. Section 011100 – SUMMARY OF THE WORK

B. Section 013500 – SPECIAL PROCEDURES: General requirements for temporary facilities and controls, to accommodate UCDH 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.

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 01740 – 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 16 – Electrical.

a. Provide and maintain warning labels on energized equipment.

b. Replace plates, electrical devices or similar existing items or components damaged as a result of temporary usage.

1.05 TEMPORARY HEATING, COOLING AND VENTILATING

A. Service Requirements:

1. Contractor shall provide temporary heat as necessary for proper installation of all work and to protect all work and materials against injury from dampness and cold and to dry out building. Fuel, equipment and method shall be approved in writing by University’s Representative.

2. Install initial services at time of site mobilization. Modify and extend systems as Work requires.

3. Maintain systems to provide continuous service, including prompt restoration of interruptions to University systems when temporary service is connected.

4. Use of permanent heating system is preferred to any other system for maintaining temperature of building during installation of finish materials, but such use will not be permitted before clean-up after plastering and/or drywall work has been completed. Contractor shall make every effort to complete permanent heating system in time for such use. Permanent fans shall not be

used before filters are installed. Filters shall be cleaned and serviced by Contractor just prior to final acceptance.

a. Vent portable units to building exterior, complete with automatic controls. Direct-fired units are not allowed. Locate units and outlets to provide uniform distribution of heating, cooling and ventilating.

b. Operate and maintain existing equipment being used; clean or replace filters and install filters in duct extensions as necessary to maintain occupied areas, work areas and finished areas, in specified condition.

c. Prior to operation of permanent equipment, verify controls and safety devices are complete, equipment has been tested, and inspection made and approved for operation.

d. Remove temporary materials and equipment when permanent system is operational. Restore existing and permanent systems used for temporary purposes to original condition.

e. Install temporary filters in air handling units and ducts, replace as necessary to prevent dust in equipment and ducts, to avoid contaminants in Work or finished areas. After completion, replace temporary filters with new, clean, reusable filters.

5. Maintain temperature, humidity, and ventilation in enclosed areas to provide ambient conditions for storage, preparation and Work; to cure installed materials, to prevent condensation, to dry floor surfaces and to prevent accumulations of dust, fumes and gases.

6. During non-working hours maintain temperature in enclosed areas occupied solely by Contractor at a minimum of 50ºF., 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 01561 – AIRBORNE CONTAMINANTS CONTROL, negative pressure

ventilation, or special control of existing system as determined by University's Representative.

B. Utility Sources:

1. Electrical: As specified above in Item 1.04.

2. Existing mechanical systems may be used for temporary purposes. Coordinate use with University for conditions to be maintained in adjacent University occupied areas.

3. Contractor shall provide and pay for all installation, operation, maintenance and removal of equipment in accordance with applicable provisions of the Electrical Safety Orders of the State of California.

1.06 TEMPORARY WATER

A. Service Requirements:

1. Maintain systems to provide continuous service, including prompt restoration of interruptions to University's systems when temporary service is connected.

2. Water service, if necessary for construction, can be made available at no expense to the Contractor provided the water is not wasted. Contractor shall be responsible for distribution of water to points of use.

3. Certified reduced pressure type back-flow prevention device as submitted to and approved by University shall be installed before water is obtained from a University campus fire hydrant or interior building connection.

B. Plumbing: Maintain system to provide continuous service with adequate pressure to outlets, including University system when temporary service is connected. See also Division 1 Approvals and ILSM requirements.

1. Size piping to supply construction needs, temporary fire protection, and for University's needs when existing service is connected.

2. Disinfect piping used for drinking water. See Division 15 for requirements.

3. Source: University existing service, connect at locations as directed by University.

4. Provide valved outlets to control water pressure adequately for hoses.

5. Fire hydrants used for water supply for construction – Contractor must use only ⅞" 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 01350 – SPECIAL PROCEDURES.

1.08 TEMPORARY TELEPHONE

A. Service Requirements:

1. Maintain systems to provide continuous service, including prompt restoration of interruptions to University systems when temporary service is connected.

2. University shall:

a. Make available existing utility/conduit infrastructure, within reason. Provide access to the existing copper and fiber infrastructure and/or allow use of said infrastructure for temporary communications service/s with the stipulation that communications services to hospital campus buildings and

services remain a higher priority to temporary construction communications.

3. Contractor shall:

a. Contractor shall provide and pay for cabling, conduit installation enhancements necessary for the services being requested for same.

b. Contractor shall pay local utility for communications services. Contractor shall also remove and return to same communications utility service

c. Contractor shall incur the costs for cabling and conduit infrastructure removal, within reason for professional appearance and functionality of communications infrastructure post departure.

B. Telephones:

1. Contractor shall use provide and use, 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:

3. Emergency Service vehicle communications.

a. Clinical Engineering medical devices

b. Plant Operations & Maintenance communication devices.

c. UCDH closed-circuit television or radio signals.

d. Cellular or other mobile phone systems in main hospital.

e. UCDH voice or digital paging systems.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Refer to UCD Division 27 for standard cabling requirements.

B. Devices and Equipment: N/A

PART 3 - EXECUTION –

UC Davis Health System

Telephone Service for Construction Trailers/Work Sites

UCDH Project Managers

When construction bids are awarded, please include this form after ordering services from AT&T. Contact IT facilities and fill out the intake form for IT project management to assist in a collaborative effort for project success. IT Facilities project management will engage IT Facilities cable engineering if additional communications connectivity assistance is required.

CONTRACTORS

UC Davis Medical Center, Innovation Technology
Email to ymsantana@ucdavis.edu
Fax # 916-734-8941
Attn: Yolanda Santana - 916-734-8000

Date: _____

Project Name: _____

Company Name: _____

Project Contact Name: _____

Phone or Cellular#: _____

Email address: _____

Location of construction site: _____

UCDHS Project Mgr: _____

UCDHS Project Mgr Phone #: _____

AT&T Order Information

Telephone number assignments: _____

AT&T Order #: _____

AT&T Due Date: _____

END OF SECTION 01 51 00

SECTION 015200
CONSTRUCTION FACILITIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Field Offices and Sheds

B. Temporary Facilities

C. Temporary Sanitary Facilities

1.02 RELATED SECTIONS

A. Section 011100 – SUMMARY OF THE WORK

B. Section 013500 – SPECIAL PROCEDURES: General requirements for temporary facilities and temporary controls to accommodate University continued occupancy, and use of the areas and spaces adjacent to construction.

C. Section 017400 – CLEANING

D. Section 017700 – CLOSEOUT PROCEDURES

1.03 FIELD OFFICES AND SHEDS

A. Field Office: Contractor shall provide a job office that will conform to the following minimum requirements:

1. Suitable space for drawings, specifications, samples and other project records.

2. Conference space for eight (8) persons, including layout tables.

3. Heating and cooling to maintain a reasonable working environment.

4. Telephone service as specified in Section 01510 – TEMPORARY UTILITIES

5. Furnishings required: Conference table and chairs; racks and files for Contract Documents, submittals, and project record documents. Other furnishings are at Contractor's option.

B. Installation: Install office spaces for occupancy fifteen (15) calendar days after date of University/Contractor agreement.

C. Preparation: Fill and grade sites for temporary structures to provide drainage away from buildings.

D. Contract Documents: Complete set of Contract Drawings and Contract Specifications shall be kept continuously at the site. Copies of all Change Orders, letters, Shop Drawings, etc., shall be kept on the job-site at all times and shall be available for inspector's use.

E. Contact numbers: Contractor shall provide telephone numbers where Contractor may be reached at all times during normal working hours and also after normal working hours, if emergency problems develop that require Contractor's assistance.

F. Storage Sheds and Containers for Materials, Tools and Equipment: If requested, University will provide space outside construction site where Contractor may provide and locate weather-tight sheds or containers for storage of construction materials, tools and equipment. Contractor shall be solely responsible for security of such sheds and containers. Size storage requirements to allow access, orderly provision of maintenance and inspection of products.

G. Cleaning: Weekly janitorial services for offices; periodic cleaning and maintenance for office and storage areas. Contractor shall keep construction loading and parking areas clear of construction debris, especially debris that may cause slipping or tripping hazard that may injure vehicle tires, that may stain surfaces, and that may be tracked into existing buildings. Maintain approach walks free of mud and water.

H. Removal: Upon completion of the work, and before the final payment, Contractor shall remove all temporary work and facilities and return site to condition required by the General Conditions of the Contract and at no change to the Contract Sum or the Contract Time.

1.04 TEMPORARY FACILITIES

A. Contractor shall provide and maintain the following temporary facilities as required for execution of the Work:

1. Scaffolding, staging, runways and similar equipment.

2. Hoists or construction elevators, complete with operators, power and signals required.

3. Temporary rigging, rubbish chutes, barricades around openings, ladders between floors, and similar equipment.

4. Barricades, fencing, lights and similar safety precautions.

B. Maintenance: Use all means necessary to maintain temporary construction facilities and controls in proper and safe condition throughout progress of the Work.

C. Replacement: In event of loss or damage, promptly restore temporary construction facilities and controls by repair or replacement at no change to the Contract Sum or the Contract Time.

D. Conformance: All materials and equipment required to safely accomplish work under this Section shall be in conformance with requirements of CAL OSHA and other State and Federal Codes and regulations where applicable.

E. Codes: All temporary work and facilities shall conform to the above requirements that pertain to operation, safety and fire hazard.

F. Construction Site Security: Temporary barriers, doors and gates shall be keyed to University's master lock system. Security hardware to be provided by Contractor. Keying to University master lock system will be provided by University.

1.05 TEMPORARY SANITARY FACILITIES

A. Use of existing facilities: Designated toilet facilities may be used by Contractor.

1. Assigned facilities: Location of assigned toilet facilities and maintenance of same are responsibility of University. Contractor shall not have exclusive use to these facilities and shall abide by health and safety criteria regarding their use and sanitary upkeep.

2. Unassigned facilities: Unassigned toilet facilities shall not be used without written authorization of University's Representative.

3. Contractor may use existing toilet facilities that are within the limits of the Work.

B. Contractor shall pay service charges for connection and use of sewage utilities.

C. Portable units: Enclosed, portable, self-contained units or temporary water closets and urinals, secluded from public view may be used. Self-contained units shall be approved by University's Representative prior to use.

1. Contractor shall pay costs of installation, maintenance and removal of temporary sanitary facilities.

2. Provide facilities at time of site mobilization.

3. Modify and extend services as work progress requires.

4. When utility services are available, provide water, sewer service, and temporary water closets; remove portable facilities. Remove temporary fixtures when permanent facilities are operational.

5. Clean areas of facilities daily, maintain in sanitary condition. Disinfect fixtures, repair or replace damaged fixtures, accessories and surfaces.

6. Provide toilet paper, paper towels, and soap in suitable dispensers.

7. Restore existing and permanent areas and facilities used to original condition.

PART 2 - PRODUCTS

2.01 MATERIALS

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

PART 3 - EXECUTION – Not Applicable to this Section

END OF SECTION 01 52 00

SECTION 015500
VEHICULAR ACCESS AND PARKING

PART 1 - 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. All permits must be purchased on cash basis.

2. Delivery of materials may be made to the job-site as required. Contractor shall coordinate with University's Representative.

3. Dumpsters shall be located in approved location as arranged by University's Representative.

C. Existing Pavements and Parking Areas: Designated existing on-site streets and driveways may be used for construction traffic. Vehicles with metal tracks will not be allowed.

1. Designated areas of existing parking facilities may be used by construction personnel. Do not allow heavy vehicles or construction equipment in parking areas.

2. Maintain traffic and parking areas in a sound condition, free of excavating

material, construction equipment, products, mud, snow and ice.

3. Maintain existing and permanent paved areas used for construction. Repair existing facilities damaged by usage to original condition: promptly repair breaks, potholes, low areas, standing water and other deficiencies, to maintain paving and drainage in original or specified condition.

4. Remove temporary materials and construction when permanent paving is usable.

1.04 TRAFFIC REGULATION

A. Schedule of Access Closing: Contractor shall adopt all practical means to minimize interference to traffic. Access to other facilities in the area shall be maintained at all times. Contractor shall provide schedule of planned closing of any street for approval by University and shall give minimum of fourteen (14) calendar days notice before closing any street or access.

B. Use of Fire Lanes: Contractor shall notify University of all major pickups and deliveries that require use of controlled access fire lanes. Keys to gates or other barriers will be provided, as needed, to allow use of fire lanes. Vehicles parked in fire lanes for delivery of materials shall be continuously manned for immediate removal if required by the University.

C. All major pick-up and delivery operations shall occur in total before or after normal working hours.

1. Drawings may indicate haul routes designated by University for use of construction traffic. Confine construction traffic to haul routes.

2. Provide traffic control at critical areas of haul routes to regulate traffic and minimize interference with public traffic.

D. Post-mounted and wall-mounted traffic control and informational signs as specified herein.

1. Traffic Control Signs, Cones, Drums, Flares, Lights and Flag Control equipment: All as approved by 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.

PART 2 - PRODUCTS – Not Applicable to this Section

PART 3 - EXECUTION – Not Applicable to this Section

END OF SECTION 01 55 00

SECTION 015600
TEMPORARY BARRIERS, ENCLOSURES AND CONTROLS

PART 1 - 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 015610 – AIRBORNE CONTAMINANTS CONTROL

D. 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 metal studs spaced 24" o/c maximum and covered on both sides with ⅝" thick Type-X rated gypsum wallboard taped, braced so to be self-supporting without fastening to existing finishes.

   a. Provide gaskets of closed cell neoprene, or strips of fiberglass insulation between barriers and existing finish.

   b. Finish exposed surfaces with two (2) coats of paint (color as selected by University), maintain in neat, orderly appearance and paint barrier on public side. Temporary emergency exit and or directional signage indicating Emergency Exits will be furnished and installed by Contractor.

   c. Provide temporary doors in corridors with twenty (20) minute fire-rated assemblies and locksets to limit use.

d. Use of access doors and routes by workmen to be approved by University's Representative.

2. Fire Retardant Enclosures - Non-Rated Assemblies: Provide non-combustible dust-proof barriers framed with metal studs and covered on public side with Fire Retardant plastic laminate sheathing material. Flame spread 10 - smoke development 45 - fuel contribution undeterminable, as manufactured by Reef Industries, Inc., P.O. Box 33248, Houston, TX 77033 or equal.

a. Joints shall be taped and sealed over framing studs.

b. Bracing shall be self-supporting without fastening to existing finishes.

c. Provide gaskets of closed cell neoprene, or strips of fiberglass insulation between barriers and existing finishes.

d. Provide non-staining taped seal to surrounding materials to insure seal.

e. Non-Rated Assemblies for Dust Control: Use ½" Type-X or equal gypsum wallboard applied on occupancy side on framing member. Joints over studs shall be taped and sealed. Other detail similar to 1.03-B.2 above.

C. Removal: Remove temporary materials, equipment and construction at completion; repair damage caused by installation or use of barricades and enclosures. Restore existing facilities used during construction to specified, or to original condition.

1.04 DIESEL VEHICLE/EQUIPMENT IDLING PROCEDURES

A. When drivers of diesel powered on-road vehicles arrive at loading or unloading areas to drop-off or pick-up passengers, supplies, equipment, materials, etc., they shall turn off their vehicle’s engine as soon as possible but no later than five minutes after arrival.

B. Operators of off-road diesel powered equipment shall turn off their engines when the equipment is not performing its primary function, but no later than five minutes after the equipment has come to a stop.

C. Idling for “warm-up” prior to diesel vehicle or equipment operations on UCDH 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 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 UCDH EH&S department.

3. Building materials containing asbestos that are part of the project shall not be disturbed or removed by the contractor during the construction of temporary barriers, enclosures and controls. The contractor shall request from the University's Representative materials that have been identified on the project to contain asbestos so that these materials are not disturbed. The contractor shall refer to Section 01350 Special Procedures, 1.05 Hazardous Materials Procedures regarding materials impacted by construction of temporary barriers, enclosures and controls.

4. All material and equipment removed as part of the Project is property of University, unless specifically designated otherwise; such material and equipment shall be delivered to a location at Medical Center, as directed by University, to be selectively sorted by University; remaining debris shall be disposed of by Contractor at no expense to University.

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 water-courses. Silt deposited as a result of the Work shall be removed and disposed of by Contractor at no cost to University.

1. Rough grade site to prevent standing water and to direct surface drainage away from excavations, trenches, adjoining properties and public right-of-ways.

2. Maintain excavations and trenches free of water. Provide and operate pumping equipment of a capacity to control water flow.

3. Provide de-watering system and pumping to maintain excavations dry and free of water inflow on a twenty-four (24) hour basis.

4. Provide piping to handle pumping outflow to discharge in manner to avoid erosion or deposit of silt. Provide settling basins to avoid silting; install erosion control at out-falls of system.

5. Remove equipment and installation when no longer needed.

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 shall coordinate with University.

1. Contractor shall pay for and maintain required permits.

2. Contractor shall furnish:

   a. National Pollutant Discharge Elimination (NPDE) permit.

   b. Contractor shall file Notice of Intent to California State Water Resources Control Board (SWRCB) stating date construction will begin. Provide copy to University.

   c. Contractor shall prepare, maintain and follow Storm Water prevention Plan. The Plan shall include Contractor's Best Management Practices (BMP) describing means and methods to control sediment, erosion and other pollutants.

   d. Contractor shall keep BMP Program at job-site.

PART 2 - 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, (no known equal).

2.02 Modular Barriers: Abatement Technologies “AIRE GUARDIAN SHIELD” containment barrier system or as-equal product.

PART 3 - EXECUTION

3.01 Infection Control Risk Assessment ICRA Requirements:

1. Refer to attached Infection Control Risk Assessment (ICRA) and UCDH 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 are 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 UC employees, an emergency telephone number of person to call 24 hours.

3. Before any demolition or construction begins, all Protection Areas (infection

control areas), control measures put in place and work plan by the Contractor will be inspected by a designated representative of UCDH. Work cannot begin until the work containment has been inspected and approved.

END OF SECTION 01 56 00

SECTION 015610
AIRBORNE CONTAMINANT CONTROL

PART 1 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 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. If visible mold is found during construction, renovation, or repairs, any ICRA in-hand is invalid and risk assessment shall be performed to reevaluate ICRA levels and the work plan prior to restart of the work. Upon discovering, seal any openings, stop work and notify the University's Representative immediately. This includes projects that are already considered and operating under a Class IV.

D. 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. Disinfect Containment and Protection Areas as directed by University's Representative

E. Dust Mitigation Requirements

1. An ICRA Daily Inspection Log ~~Compliance Survey~~ 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.

F. 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 building including number of negative air units and sizes (cfm), and location of sealed blocked off areas of corridors. Any impacts to corridors will need to be approved via ILSM (see specification section 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 contactors' proposed foreman has successfully obtained one of the following from the American Society for Healthcare Engineering (ASHE):

a. Certified Healthcare Constructor (CHC) Certification

b. Health Care Construction (HCC) Certificate

c. Managing Infection Prevention During the Construction & Operation of Health Care Facilities Course Completion

1.04 QUALITY CONTROL

A. Pre-construction Meeting: Before any construction on site begins, **Contractor's** Superintendent is required to attend a mandatory pre-construction orientation session held by University's Representative for a review on precautions to be taken.

B. Review by PO&M HVAC staff for possibility to disconnect air supply and return into the project area. Negative air machines shall be connected to separate electrical circuits.

C. Notification: A minimum of fourteen (14) calendar days written notification to University's Representative of possible construction activity causing airborne contaminants in Protection Areas.

1.05 DEFINITIONS

A. Containment Areas: As determined by University's Representative and if shown. Includes all areas of construction activities, adjacent staging and storage areas, and passage areas for workers, supplies and waste. The containment area includes ceiling spaces above and adjacent to construction activities.

B. Critical Openings – Include all potential paths for air and contaminants to move from the project area to outside of the project area and include: supply registers, return registers, exhaust registers, doors, windows, and other openings within the area where contaminants can escape. Sealing the critical openings can be accomplished with tape, plastic, hard barriers and a combination of these materials to seal airtight the critical opening.

C. HEPA System DOP Testing – An ANSI / ASTM recognized method to test the integrity of a High Efficiency Particulate filter which filters out 99.97% of particles 0.3 micrometers or larger. DOP testing is performed by specialty **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 four precaution levels. The ICRA program is documented in Hospital P&P 2120. ICRAs apply to patient care areas and their adjoining contiguous areas. All ICRA evaluations are the sole responsibility of the Health System Infection Prevention Department based on an application by the Project Manager. 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 (IV) and approved ICRA Permit.**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.

3. **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.

4. 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 Permit Extension Form 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.

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. Reference approved ICRA Permit 21-163.

B. THE BELOW LISTED CRITERIA ARE POSSIBLE STRATEGIES FOR CLASS 3 AND 4 CONTAINMENTS. NOT ALL OF THE STRAGEGIES WILL BE ALLOWED OR REQUIRED. THE ICRA PERMIT AND EH&S WORKSHEET DEFINE WHAT IS ALLOWABLE. THINK OF THE ICRA PERMIT AND EH&S WORKSHEET AS A MENU. THE BELOW IS A DETAILED DESCRIPTION OF EACH ITEM ON THAT MENU.

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. Regardless of containment strategies, execute work by methods to minimize raising dust from construction operations. Water may be used to assist in controlling airborne dust.

D. Full containment

1. All surfaces in the containment area except surface where work is to occur must be covered in plastic unless they are non-porous, smooth, and accessible for cleaning.

2. Sealing of Openings: Use tape or other impenetrable sealant to seal barrier wall seams, cracks around window and door frames, exhaust system ductwork, pipes, joints and ducts. Use of spray glue is not acceptable to be used inside of the building.

3. **Contractor** must block off existing ventilation supply registers, return registers and exhaust registers in the construction area.

4. All polyethylene and other materials used for temporary enclosures shall be at least 6 mil thickness and fire-retardant type. Zip poles or other easily removable supports shall be used for projects extending beyond one work shift. Temporary walls with metal stud framing may be required for long term projects and must be approved by the Project Manager. All doors leading into the containment area shall utilize zippered doors for control of the air flow and closing the plastic doors.

E. Critical seal of areas

1. Use tape or other impenetrable sealant to seal barrier wall seams, cracks around window and door frames, exhaust system ductwork, pipes, joints and ducts. Use of spray glue is not acceptable to be used inside of the building.

F. Cubes

1. Mini-containments (pop-up cubes) which are designed to have at most 1-2 people are means of control to access attic spaces, wall spaces and subfloor spaces usually at defined entry points such as access hatches or above a drop-in ceiling system. Cubes are reviewed and approved by the University's Representative on a case by case basis.

G. Glove Boxes

1. A glove box can be used for some work where a HEPA filtered vacuum is attached to the glove box when a small area of work is to be performed. A glove bag is attached to the box enclosure to allow the worker to make small openings by drilling or cutting within the negative pressure glove box. Glove boxes are reviewed and approved by the University's Representative on a case by case basis.

H. Shrouded tools

1. Shrouded tools can be used for some work. A HEPA (DOP Tested) filtered vacuum is attached to the shroud. Shrouded tools are reviewed and approved by the University's Representative on a case by case basis.

3.03 NEGATIVE AIR CRITERIA

A. Under no circumstances shall the HEPA filtered air be discharged into existing HVAC returns, exhaust ducting or building plenum spaces.

B. When the air from the HEPA filtered negative air unit exhaust cannot be directed outside of the building due to no windows in the vicinity of the work or if impractical, all HEPA filtered negative air units shall be exhausted to a location agreeable to the PM. Each HEPA unit shall be plugged into a separate electrical circuit to provide temporary redundancy should one unit fail or due loss of electrical power. The PO&M Electrical shop shall inspect and test each circuit connected to the HEPA negative air unit prior to use.

C. When the air from the negative air units 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.

D. Negative air units shall be positioned as far from the entry ante room containment as possible for distribution of air flow throughout the project area. The number of negative air units shall be to provide sufficient negative pressure and for a minimum of at least four (4) air changes per hour of the volume of the entire work containment.

E. Dual HEPA Units operating in parallel may be required for redundancy in high-risk areas.

F. DOP testing of HEPA equipment

1. Negative air units and HEPA filtered vacuums are to be challenge tested onsite by the DOP test method by a third party prior to being placed in service, after a HEPA filter change, when dropped or damaged or moved from the project site. Only HEPA systems that pass the challenge DOP testing can be used on the project. All HEPA equipment shall be tested per ANSI/ASME N510 Section 10 to ensure 99.97% efficiency at 0.3 micrometer mean aerodynamic diameter.

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

3. When utilizing HEPA Filtered Vacuums for glove boxes or shrouded tools these HEPA Vacuums must be DOP tested.

3.04 NEGATIVE AIR MONITORING CRITERIA

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

1. Build containment with negative air machines capable of maintaining a pressure differential of -0.020 in-WC across all critical barriers

2. Demonstrate negative pressure is achieved continuously (24/7) by means of an electronic manometer sensitive to measure down to -0.020" wp. An Omniguard IV recording manometer is recommended as the standard instrument for containment pressure monitoring, but other electronic manufactured models with similar sensitivities at low pressures and recording capabilities are acceptable.

B. Hybrid Monitoring and Visual Verification

1. Build containment with negative air machines capable of maintaining a pressure differential of -0.020 in-WC across all critical barriers.

2. During the course of construction, the scope of work may dictate removal of work (e.g. Ceilings or drywall) that would make it difficult to maintain -0.02 in-WC of negative pressure. During working hours Visual Verification of negative pressure may be used in lieu of the -0.02 in-WC requirement with electronic monitoring.

3. At the end of shift all openings must be sealed to bring the containment back to the -0.020 in-WC requirement.

C. Visual Verification

1. The containment shall be visually inspected to verify the plastic is bowed inward to the project area. Tell tail ribbon may also be used to confirm negative pressurization. Visual Verification of negative pressure without the use of a manometer shall be performed upon first entry to the work area, during the course of the work, especially if there are any changes to the work space that may change the negative pressure, prior to taking any breaks and at the end of the work period.

3.05 ADDITIONAL CONTAINMENT CRITERIA

A. Ante Room

1. An ante room is a separate chamber attached to the containment area with zippered doors to allow entry and exit into the containment area. Entry into the containment area shall be only via the ante room. The ante room is commonly constructed of zip poles or equivalent, plastic and tape. The ante room is sized for each project to allow workers and equipment to be moved into and out of the containment area. A sticky mat is required in the ante room for workers and carts on wheels to use when existing the ante room from the containment area. The zippered doors are to remain closed or adjusted slightly open as necessary to allow negative pressure to be maintained at least -0.020 in-WC.

2. The ante room shall have a sticky mat present which is intended to remove any debris from the bottom of work shoes before leaving the ante room into the public area. The sticky mat is not intended to clean debris from the bottom of disposable coveralls or from booties. The sticky mat layers shall be replaced many times during a work shift when work involves movement of many workers and supplies out of the containment area. The **Contractor** is responsible for removing a dirty sticky mat and replacing it with a clean one when it is necessary.

3. Workers entering into the containment area will put on a full body disposable coverall with booties inside of the ante room before entering the containment area. Entry into the ante room requires one of the two zippered doors to be opened at one time to maintain the required negative pressure. After entering the ante room, the zipper shall be closed before leaving the ante room into the containment area.

B. Air Scrubbing

1. The **Contractor** shall place additional HEPA filtered fan units (negative air unit) inside of the project work area and operate them in recirculation mode or “scrub mode” near the final cleaning phase of the project to aide in additional particulate cleaning of the space. These units will circulate air internal to the containment area and scrub the air to reduce the total airborne particle concentrations inside of the containment area.

C. Disposable Coveralls and Booties

1. Disposable coveralls are required in all Class IV containment areas and selected to provide protection of street clothes from particulates generated inside of the

containment area. Disposable coveralls shall be changed if they become ripped and are no longer serviceable.

2. Proper use of the disposable coveralls, booties and use of the sticky mat shall be followed at all times for all workers and 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.

C. Additional HEPA filtered negative air units may be installed for scrubbing of particles (see 3.05 B).

D. 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.

E. Particle count assessment may be made inside of the containment area by the University's Representative as part of the final visual inspection process in addition to the final visual inspection. Particle testing will include testing the airborne concentration of various particle sizes compared to the concentration outside of the containment area. If particle counts inside of the containment area are significantly greater than outside of the containment area, the **Contractor** shall continue to scrub the air inside of the project area with HEPA filtered negative air units and conduct additional surface cleaning until subsequent particle testing has demonstrated particle concentrations inside of the containment area are not

significantly greater than particle concentrations immediately outside of the containment area.

3.08 ENTRY/EGRESS

A. Entry into the project containment area shall be through the ante room. Entry into the ante room requires one of the two zippered doors to be opened at one time to maintain the required negative pressure. After entering the ante room, the zipper shall be closed before leaving the ante room into the containment area. Equipment and supplies brought into the containment area shall be in sealed leak tight containers inside of rolling covered carts. Equipment, tools and supplies brought into the building shall be clean and free of dust, debris, mold and other contaminants. Cardboard products shall not be brought into the containment area if they are water damaged or have suspect mold growth.

B. All HEPA equipment when transported into and out of the containment area shall be cleaned of all debris on the surfaces and shall have the intake openings sealed with plastic and duct tape.

C. All workers leaving the containment area shall leave in clean clothes. At no time shall disposable coveralls or booties be worn when leaving the containment area through the 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

Infection Control Risk Assessment

ICRA Committee approval of an ICRA Permit is required for all Construction Activity

Fill-out form completely or indicate NA on individual items

Date: 11/5/21

Requested ICRA
(See Steps 1, 2 and 3)

Construction Type Type C
Risk Level Medium Risk
Classification Class III

Submitted by: Sally Fernandez
Dept/Firm: Kitchell
Cell Phone: 916-203-7166

Project Location/Address: ACC Net V II Upgrades
Building name, Floor, Suite/Room: ACC

FD&C Project Number or Other Identifying Number: 9559430

Type of Patient Care within Area of Work: none
Type of Patient Care in Adjacent Areas: none

Project Scope Description:

Installation of cabling infrastructure, IT racks, cooling systems, UPS.

Describe Work Plan:

Installing seismic anchors/supports, relocating existing utilities, installing IT racks, UPS, associated ducting, electrical, cooling.

Required Documents

- Infection Control Risk Assessment
- Infection Control Construction Permit form
- UCDH Construction Dust & Hazardous Materials Inspection Worksheet form
- ICRA/Project Floor Plan (work area / floor plan, and path of travel plan)

Infection Control Risk Assessment

Matrix of Precautions for Construction & Renovation

STEP 1

Use the following table to identify the Construction Type A, B, C or D

TYPE A	**Inspection and Non-Invasive Activities**. Includes, but is not limited to: ƒ removal of ceiling tiles for visual inspection only, e.g., limited to 1 tile per 50 square feet ƒ painting (but not sanding) ƒ wallcovering, electrical trim work, minor plumbing, and activities which do not generate dust or require cutting of walls or access to ceilings other than for visual inspection.
TYPE B	**Small scale, short duration activities which create minimal dust** Includes, but is not limited to: ƒ installation of telephone and computer cabling ƒ access to chase spaces ƒ cutting of walls or ceiling where dust migration can be controlled.
TYPE C	**Work that generates a moderate to high level of dust or requires demolition or removal of any fixed building components or assemblies** Includes, but is not limited to: ƒ sanding of walls for painting or wall covering ƒ removal of floorcoverings, ceiling tiles and casework ƒ new wall construction ƒ minor duct work or electrical work above ceilings ƒ major cabling activities ƒ any activity which cannot be completed within a single work shift.
TYPE D	**Major demolition and construction projects** Includes, but is not limited to: ƒ activities which require consecutive work shifts ƒ requires heavy demolition or removal of a complete cabling system ƒ new construction.

Step 1 - Construction Type: Type C

STEP 2

Use the following table of **Patient Risk Groups** to identify the **Risk Level (Low, Medium, High, Highest)** posed by the project. Also, provide further description of uses /risk groups as necessary that are not otherwise listed in the table. If more than one risk group will be affected, select the higher risk group:

Low Risk	Medium Risk	High Risk	Highest Risk
➢ Office Areas ➢ Administrative Areas ➢ Unoccupied areas with no/minimal adjacent patient care activities OTHER:	➢ Cardiology ➢ Echocardiograpghy ➢ Nuclear Medicine ➢ Physical Therapy ➢ Radiology/MRI ➢ Respiratory Therapy ➢ all outpatient care sites not otherwise listed ➢ Public Corridors ➢ Lobbies & Waiting Rooms ➢ Cafeteria OTHER:	➢ CCU ➢ Emergency Room ➢ Labor & Delivery (non-OR) ➢ Laboratories (specimen) ➢ Medical Units ➢ Newborn Nursery ➢ Outpatient Surgery ➢ Pediatrics ➢ Pharmacy areas not listed otherwise ➢ Post Anesthesia Care Unit ➢ Surgical Units ➢ Food Preparation Areas OTHER:	➢ Any area caring for immunocompromised patients ➢ Burn Unit ➢ Cardiac Cath Lab ➢ Central Sterile Supply ➢ Intensive Care Units ➢ Negative pressure isolation rooms ➢ Oncology ➢ Operating rooms including C-sections rooms ➢ Endoscopy ➢ Pharmacy admixture areas ➢ Transplant units ➢ Dialysis ➢ Interventional Radiology ➢ OR support spaces including anything beyond "red line" OTHER:

Step 2 - Risk Level: Medium Risk

STEP 3

Use the table below to determine the ICRA Classification.

Patient Risk Group (*Low, Medium, High, Highest*) with the planned **...**
Construction Project Type (*A, B, C, D*) on the following matrix, to find the
Class of Precautions (*I, II, III or IV*) or level of infection control activities required.
Class I-IV or Color-Coded Precautions are delineated on the following page.

	CONSTRUCTION PROJECT TYPE			
PATIENT RISK GROUP	**TYPE A**	**TYPE B**	**TYPE C**	**TYPE D**
LOW Risk Group	I	II	II	III / IV
MEDIUM Risk Group	I	II	III	IV
HIGH Risk Group	I	II	III / IV	IV
HIGHEST Risk Group	II	III / IV	III / IV	IV

Step 3 – Classification Determination: Class III

Infection Control Construction Permit (Post At Job Site)

ICRA Permit No: 21-163			**ICRA Class:** III		
Location of Construction: ACC			**Project Start Date:** 1/15/22		
Project Coordinator: Sally Fernandez			**Estimated Duration:** 6 month		
Contractor Performing Work:			**Permit Expiration Date:** 7/15/22		
Supervisor: Ken Pickett			**Telephone:** 916-203-7166		
YES	**NO**	**CONSTRUCTION ACTIVITY**	**YES**	**NO**	**INFECTION CONTROL RISK GROUP**
		TYPE A: Inspection, non-invasive activity			GROUP 1: Low Risk
		TYPE B: Small scale, short duration, moderate to high	✔		GROUP 2: Medium Risk
✔		TYPE C: Activity generates moderate to high levels of dust, requires greater 1 work shift for completion			GROUP 3: Medium/High Risk
		TYPE D: Major duration and construction activities requiring consecutive work shifts			GROUP 4: Highest Risk

CLASS I	1. Execute work by methods to minimize raising dust from construction operations. 2. Immediately replace any ceiling tile displaced for visual inspection. 3. Clean work area upon completion of task
CLASS II	1. Isolate HVAC system in area where work is being done to prevent contamination of the duct system. 2. Complete all critical barriers or implement control cube method before construction begins. 3. Place dust mat at entrance and exit of work area. 4. Water mist work surfaces to control dust while cutting. 5. Contain construction waste before transport in tightly covered containers 6. Wipe surfaces with cleaner/disinfectant. 7. Remove barrier materials carefully to minimize spreading of dirt and debris.
CLASS III **Date** 11/22/21 **Initial** CM	1. Isolate HVAC system in area where work is being done to prevent contamination of the duct system. 2. Complete all critical barriers or implement control cube method before construction begins. Seal holes, pipes, conduits, and punctures appropriately. 3. Place dust mat at entrance and exit of work area. 4. Maintain negative air pressure utilizing HEPA equipped air filtration units to control dust. 5. Vacuum work with HEPA filtered vacuums. 6. Wipe surfaces with cleaner/disinfectant. 7. Contain construction waste before transport in tightly covered containers. 8. Do not remove barriers from work area until complete project is clean and checked by Environmental Health and Safety or its representative. 9. Remove barrier materials carefully to minimize spreading of dirt and debris.
CLASS IV **Date** **Initial**	1. Isolate HVAC system in area where work is being done to prevent contamination of the duct system. 2. Complete all critical barriers or implement control cube method before construction begins. Seal holes, pipes, conduits, and punctures appropriately. 3. Place dust mat at entrance and exit of work area. 4. Maintain negative air pressure within work site utilizing HEPA equipped air filtration units. 5. Construct anteroom and require all personnel to pass through room so they can be vacuumed using a HEPA vacuum cleaner before leaving work site, or personnel can wear cloth or paper coveralls that are removed each time they leave the worksite. 6. All personnel entering work site are required to wear shoe covers. 7. Contain construction waste before transport in tightly covered containers. Utilize tape coverings. 8. Vacuum work area with HEPA filtered vacuums. 9. Wipe surfaces with cleaner/disinfectant. 10. Do not remove barriers from work area until complete project is clean and checked by Environmental Health and Safety or their representative. 11. Remove barrier materials carefully to minimize spreading of dirt and debris.

Additional Requirements:

Permit Requested By: SALLY FERNANDEZ	Permit Authorized By: COLIN MCGLYNN, E-SIG
Date: 11/22/21	Date: 11/22/21

UCDH Construction Dust & Hazardous Materials Inspection Worksheet

ICRA Permit Number 21-163	**ICRA Class** III
Job # and Name ACC Net V 2	**Project Manager** Ken Pickett
Estimated Start 1/15/22	**Estimated Completion** 7/15/22

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)	report
By Whom: (name & department)	Entek

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 UCDMC
✔	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: redline
✔	Pre-Work Approval Inspection	□ EH&S ☑ Consultant □ Other:
✔	Daily Onsite Oversight	□ PM □ EH&S □ Consultant □ IOR ☑ Other: CM
	Air Sampling Type:_____ Frequency:_____	□ EH&S □ Consultant □ Other:
✔	Post Demolition or Abatement Inspection	□ PM □ EH&S ☑ Consultant □ IOR □ Other:
	ICRA Downgrade	□ PM □ EH&S □ Consultant □ IOR □ Other:
✔	Final Visual Approval Containment Inspection	□ PM □ EH&S ☑ Consultant □ IOR □ Other:

ICRA Permit Extension Request

Date		
ICRA Permit No.		
Original ICRA Permit Approval Date		
Approved Permit Classification	Construction Type Type A Risk Level Low Risk Classification Class I	
Requested Permit Expiration Date		
Project Location (Building & Floor/Room)		
Brief Description of Work		
Contact Information	Name:	
	Phone:	
	Email:	
Are there any current or planned changes in the project or work activities affecting the current ICRA Permit Classification? **Initial:** YES ____ NO ____		
Have any issues arisen during project activities affecting air quality requiring greater infection prevention controls or health safety measures not covered by the current ICRA Permit? **Initial:** YES ____ NO ____		
Project activities are occurring in accordance with the current ICRA Permit requirements. **Initial:** YES ____ NO ____		
Applicant Signature:		
Permit Extension Approved: (UCDH Infection Prevention)		**Date:**_____ **Permit Expiration Date:**_____
Further Review Required *		**Date:** _____
***Please return to the ICRA Committee with the requested permit extension for further discussion and determination.		
NOTE: ICRA permits are extended only 6 months at a time Approved Project Risk Assessment and ICRA Permit, EH&S Worksheet, Project ICRA Plan(s)		

Procedure – ICRA Permit Extension

1. Submit Extension Request to UCDH Infection Prevention (IP):

   Colin McGlynn - ccmcglynn@ucdavis.edu

   Send email copies also to -

   James Dunbarr – jjdunbarr@ucdavis.edu
   Dave Daly – drdaly@ucdavis.edu

2. IP Review of Permit Extension –
   a. Request Approved – Go to Step 3;
   b. Refer to Applicant to re-submit to ICRA Committee for further review

3. Approved permit extension –
   a. ICRA Permit Log on Microsoft Teams updated and document uploaded to Microsoft Teams archive folder by IP
   b. Document emailed to Applicant

UC DAVIS MEDICAL CENTER
CONSTRUCTION DUST INFECTION PREVENTION
BEST PRACTICE STANDARD
VERSION 3.0 - OCTOBER 2016

I. PURPOSE

This document represents the minimum best practice standards to prevent the acquisition of nosocomial infection in patients due to exposure to potentially infectious or injurious dusts created by construction/renovation/maintenance activities.

A*spergillus* fungal spores carried on dust particles are the most common cause of construction related infection in healthcare settings. Overall mortality from a healthcare construction/renovation related fungal infection is 50%. Infection due to construction in healthcare facilities is estimated to cause 5,000 deaths each year in the United States.

The Project Manager, Infection Control and Environmental Health & Safety will audit performance to this standard, as amended by the needs of specific projects. All users of this standard are authorized to contact EH&S directly with questions or for consultation.

II. SETTING

All work which has undergone an evaluation by IC and EH&S and has received an Infection Control Risk Assessment (ICRA) permit for construction, remodeling, maintenance or repair activities at University of California, Davis Medical Center (UCDMC) facilities. This includes external construction and work at leased facilities where owner-provided contractors are used.

EXCLUSIONS

Work taking place in non-patient care areas such as School of Medicine facilities and medical research facilities is excluded.

This standard does not apply to projects contacting hazardous materials, such as asbestos, lead, chemical or radioactive materials. Projects involving hazardous materials must undergo additional assessment and approval processes. Should hazardous materials be discovered during the course of work, immediately contact UCDMC Environmental Health & Safety (EH&S) and Infection Control (IC) for additional risk assessment.

III. DEFINITIONS

Anteroom – a small room connected to the entrance of the negative pressure containment, used for donning/doffing protective clothing and adding a layer of insulation between the containment and hospital environment; required on Class IV containments.

Containment – system of barriers and/or negative pressure equipment which isolates the construction zone air space from the adjacent hospital environment.

Critical Barrier – barrier sealed over critical openings into the work area such as: HVAC vents, doorways, electrical outlets, gaps in drop in ceilings or other openings.

DOP test – filter challenge test; a standard recognized method to test the integrity of a HEPA filter using dispersed oil particulate (DOP) and particle counting techniques which is performed by a specialty contractor.

HEPA filter – High Efficiency Particulate Air (HEPA) filter which removes 99.97% of particles 0.3 micrometers and is even more efficient for particles of other sizes.

Immunocompromised - having a weakened immune response due to an infection, disease or immunosuppressive agent such as a medication or irradiation.

Infection Control Risk Assessment (ICRA) – process which evaluates patient risk due to construction activities focused on reducing the risk of infection; based on a matrix of the affected

patient population and the invasiveness of the work. This assessment generates a permit issued by Infection Control requiring compliance with one of four precaution levels (classes). See UCDMC Hospital Policy and Procedure 2120.

In writing – written, hard copy or electronic communications. Electronic communications must be retained in the same manner as hard copy documents.

Manometer – pressure measuring instrument, typically reads differential pressure between two spaces.

Negative pressure – pressure within a system that is less than the environment that surrounds that system; having atmospheric pressure that is less than the ambient atmospheric pressure. Examples: vacuum flask (thermos) interstitial space, airborne infectious agent isolation room.

Non-porous – free from minute spaces or holes (pores) where contamination may be trapped; smooth.

Nosocomial Infection - hospital-acquired infection; infection contracted from the environment, staff or operations of a healthcare facility.

Particle Counting – method of determining ambient particulate concentrations of various sized airborne particles using laser diode and photodetector; not specific to the nature of sampled particle.

Poly – polyethylene sheeting; plastic film sheeting used to contain contamination.

Positive pressure – pressure within a system that is greater than the environment that surrounds that system; having atmospheric pressure that is greater than the ambient atmospheric pressure. Example: inside of an inflated balloon or tire.

Patient Care Area - location where patient care is provided, not limited to direct treatment and can include waiting rooms, lobbies, food service areas, and other places throughout the facility where patients may be present. Infection risks are elevated in these locations as immunocompromised patients are concentrated in these locations.

IV. RESPONSIBILITIES

All parties to this standard must primarily act in the best interests of patients and patient care, regardless of impact to project timelines or other constraints.

PROJECT MANAGER

The Project Manager (PM) is the Facilities Design and Construction (FD&C) or Plant Operations and Maintenance (PO&M) representative overseeing project execution. The PM is responsible for overseeing the contractor or in-house personnel performing the work. A third party construction manager may be used to supplement the PM's duties but the UCDMC PM retains all responsibility under this best practice standard.

The project manager shall ensure:

- All work is performed under an approved ICRA
- An Interim Life Safety Measure (ILSM) plan is created, if necessary
- Coordination with work area stakeholders regarding the potential impacts to patient care including the containment location, project duration and any changes during the course of construction
- This best practice document is followed throughout the duration of the project
- A qualified consultant is hired for all significant projects (as determined by agreement between FD+C and EH+S), and projects which take place after hours or on weekends

- Plans and specifications (bidding documents) are developed which in accordance with this best practice standard
- Containment inspectors and consultants perform to this best practice standard
- Contractor expectations are communicated in writing prior to the start of work
- Contractor complies with plans specifications and approved ICRA permit precautions.
- Routine containment inspections are performed and documented by a trained, qualified containment inspector
- Project documentation is maintained
- Containment failures or serious breaches of practice are communicated to EH&S and IC in writing as soon as possible
    - Root causes of failures are determined and corrective action is taken to prevent future episodes
- Work is stopped for excessive noise/vibration, breach of containment, non-compliance with this best practice standard or other patient care is compromised by the work
- Environmental Services (EVS) is contacted for a terminal clean of the project area after a successful final inspection and containment dismantlement

CONTRACTOR

The contractor is responsible for complying with all provisions of plans, specifications and approved ICRA permit precautions to control construction dust at the project site. These provisions include witnessed DOP testing of all HEPA filtered equipment.

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. 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 the PM, EH&S or IC.

CONTAINMENT INSPECTORS

Containment inspectors may perform any of the inspections listed in the "Inspection Criteria" section except for the initial containment inspection (aka "Pre-start"). Containment inspectors must be trained by EH&S (or a qualified consultant) and report to the PM and EH&S.

ENVIRONMENTAL HEALTH AND SAFETY

Environmental Health and Safety (EH&S) is responsible for providing consultation services related to this best practice standard, auditing containment inspector and consultant performance; and updating this best practices document.

EH&S is responsible for ensuring either EH&S or the consultant performs the following:

- Witness DOP testing of HEPA filtered equipment or perform particle count challenge testing in rare cases
- Complete site inspections according to this best practice standard (must perform the pre-start inspection and approve of the containment design)
- Audits of contractor performance, including particle counting
- Training of containment inspectors
- Environmental sampling, as needed
- Investigation of containment failures
- Stop work for excessive noise/vibration, breach of containment, non-compliance with this best practice standard or other patient care is compromised

- Along with IC, approve any deviations to this best practice standard

INFECTION CONTROL

The Department of Hospital Epidemiology and Infection Control (IC) is involved in many facets of the control and prevention of nosocomial infections at UC Davis Health System, including infections from construction dust. The IC Department reviews and approves Infection Control Risk Assessments (ICRAs) of construction projects; along with EH&S, approves temporary deviations to this best practice standard to support unique scenarios; and approves this best practice standard document. IC may audit compliance with this Standard and has the authority to stop work for: excessive noise/vibration, breach of containment, non-compliance with this standard or other project issues which compromise patient care.

ENVIRONMENTAL SERVICES

Environmental services (EVS) personnel perform terminal cleaning of project areas once containments have been removed (per UCDMC Hospital Policy and Procedure 14800). The PM is required to provide a 24 hour notification to EVS 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.

EVS personnel also occasionally perform final clean inspections for some work.

CONSULTANTS

Consultants retained by either FD&C or PO&M provide project scoping, planning, specification and work plan development, project monitoring for compliance with this standard, and inspection services. Consultants shall be approved by EH&S on the basis of education, training, and experience prior to beginning billable work. Consultants may only use qualified employees, trained and experienced with infection prevention and construction dust control in a hospital setting.

Consultants shall be directed by the PM and shall communicate with EH&S, in addition to the PM.

V. POLICY

All work which has received an ICRA Class III or IV permit must be completed using a negative pressure containment system, designed to separate the construction air space from the hospital environment. This system is composed of an enclosed work area and HEPA equipped filtration units providing negative pressure to the work area.

The following policies shall apply to all personnel working with negative pressure containments at UCDMC facilities.

TRAINING

All personnel working with negative pressure containments shall be trained and knowledgeable in the following:

- ICRA Permit contents and requirements
- Site Specific Containment plan
- Requirements of this best practice standard
- Infection risks associated with construction
- Methods to control the dissemination of dust and fungal spores
- Proper use of protective clothing

- Proper entry and exit procedures
- Manufacturer's requirements, where manufactured containment systems are used (e.g., cubes)
- How to respond to a loss of negative pressure or too much negative pressure
- Breach in Practice response and required notifications

Contractors shall be additionally trained in the following:

- Proper containment design, construction and maintenance techniques
- Proper load out techniques for equipment/wastes
- Containment cleaning regime: daily, final and terminal cleaning

Containment Failure Emergencies caused by the contractor may require retraining at the discretion of the PM, IC or EH&S. Training is to be provided by EH&S or an EH&S approved training provider, such as a consultant.

EXPERIENCE

Contractors, consultants and containment inspectors shall demonstrate the following experience requirements prior to performing duties under this standard.

CONTRACTORS

In order to be considered qualified to work with negative pressure containments, contractors must demonstrate experience by providing either of the following:

- 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.
- Documentation that the contactors' proposed foreman has successfully obtained one of the following from the American Society for Healthcare Engineering (ASHE):
    - Certified Healthcare Constructor (CHC) Certification;
    - Health Care Construction (HCC) Certificate; or
    - Managing Infection Prevention During the Construction & Operation of Health Care Facilities Course Completion

CONSULTANTS

In order to be considered qualified to work with negative pressure containments, consultants must demonstrate all of the following:

- Hands-on oversight by a Certified in Industrial Hygienist (CIH) in good standing with the American Board of Industrial Hygiene (ABIH)
- Field personnel shall be experienced in Healthcare Construction Infection Prevention and shall possess certification in good standing by Cal/OSHA as a California Certified Asbestos Consultant (CAC) or Certified Site Surveillance Technician (CSST)
- Owner references for previously completed, documented negative pressure containment oversight work in a healthcare facilities

CONTAINMENT INSPECTORS

Containment inspectors may be trained, in-house UCDMC personnel or outside, third-party consultants. All containment inspectors shall be approved by EH&S prior to commencing inspection tasks. Approval shall include ensuring familiarity with the following:

- Operation, maintenance and inspection of HEPA filtered equipment

- Methods to achieve and maintain negative pressure in containments
- Methods to monitor negative pressure
- Inspection elements and documentation requirements

EQUIPMENT

Equipment used for construction containments must arrive free and clean of any debris or significant dust. Equipment which cannot be thoroughly decontaminated must arrive wrapped in 6 mil (0.006 inches) polyethylene sheeting, be used only within negative pressure containment, be wrapped prior to transport out of the containment, and be transported offsite in a covered cart.

All polyethylene sheeting shall be flame retardant and at least 6 mils thick. Waste bags shall be 6 mils thick.

All HEPA filtered equipment must be tested prior to being utilized to ensure integrity of the filter and housing. The equipment is to be tested onsite by standard dispersed oil particulate (DOP) challenge testing using a, certified independent testing contractor. In rare cases or emergencies, EH&S or an approved consultant may perform onsite particle challenge testing of HEPA filtered equipment. A legible label indicating the date tested, testing party and expiration date must be affixed to the equipment in order for it to be considered compliant with this best practice standard.

Both DOP and particle tests shall be valid for 6 months from the date of initial testing, provided the contractor certifies and can verify that the machines have remained at the same building with the same filters in place since initial testing and have not been moved, modified, inverted or roughly handled in that time. Previously tested equipment which has been removed from the building shall be tested before being reutilized onsite.

VI. PROCEDURE

The following best practice procedures must be used wherever possible when working with negative pressure containment systems.

WORK PRACTICES

To minimize the creation of airborne dust, capture and control dust as close to the source of generation as possible. Use water mist, HEPA vacuums, vacuum tool attachments and/or other methods to prevent the spread of dust within the containment.

Clean as you go and cleanup promptly. Vacuum up dust as it is generated. Vacuum out exposed cavities as soon as they are made accessible. The contractor shall perform daily cleaning of the containment interior by HEPA vacuuming any obvious dust and bagging up debris. Do not leave debris in an unoccupied containment.

Contractor shall inspect the containment daily prior to starting work and immediately repair any breaches, holes or other issues.

Stop work and notify the PM immediately if unforeseen hazardous materials (including mold) are discovered during the course of construction. This condition will warrant a reassessment of the project by IC and EH&S.

Use only tested, HEPA filter equipped vacuums. Do not use standard shop vacuums; all vacuums without HEPA filters are dust distributors.

Avoid dry sweeping, dry shoveling or other dry debris cleanup. Use a water mist or sweeping compound prior to sweeping or shoveling debris. Do not use compressed air on dust or debris.

In occupied areas, provide an effective means of diffusing the air exhausted from HEPA filtered negative air machines.

PROTECTIVE CLOTHING

Class IV containments require the use of protective clothing, including shoe covers. The purpose of this clothing is to protect street clothing from becoming contaminated during work and prevent the track out of dust.

Shoe covers may be attached to protective suits or may be worn separately. Head coverings are not required unless dust creation is expected to be extensive, as in the case of abrasive blasting or concrete coring, or head exposure is likely, as in the case of attic crawling. Protective clothing may be disposable (e.g., Tyvek suits) or reusable and regularly laundered.

Note that disposable suits are not typically fire resistant and, therefore, not intended for hot work environments. If fire resistive clothing is necessary, it must be brought onsite in a sealed bag, used only within containment and re-bagged and sealed prior to offsite transport.

DECONTAMINATION

Workers and equipment must be carefully decontaminated before exiting the containment to avoid tracking construction dust out into the hospital environment.

PERSONNEL

For exceptionally dusty work, prior to removing protective clothing, clean the outside surface using a HEPA equipped vacuum or damp towel/sponge which is frequently rinsed in clean water. To avoid chemical hazards, do not use disinfectants to wipe skin or protective clothing.

If respiratory protection is used, remove protective clothing prior to doffing respirator.

When removing protective clothing, roll the suit outwards and down the body such that the exterior side is rolled into itself and only the clean side of the suit is exposed. Only touch the inside (clean side) of the suit.

Step out of the suit and discard into a waste bag for disposal or plastic bag for laundering. If shoe covers are not attached to the suit, remove them next by rolling the dirty side onto itself.

Step onto the tack mat and step several times to remove fugitive dust before stepping onto flooring outside of the work area.

When working in semi-restricted or restricted areas, put on clean protective clothing prior to entering the semi-restricted or restricted area located outside of the negative pressure containment.

Wash face, hands and any exposed skin surfaces as soon as possible upon exiting containment. For dusty work, a wash station near the work area may be required.

EQUIPMENT & WASTES

Decontaminate the exterior surface of all bagged waste, tools, or construction materials prior to exit of the containment by wet wiping. Tools or materials which cannot be exposed to water may be thoroughly HEPA vacuumed prior to removal.

Contaminated construction materials, tools, or other reusable items contaminated with dirt or debris must be wrapped in 6 mil plastic sheeting or in bags any time they are outside of the containment and prior to covered cart transport. Insides of transport carts shall be maintained free and clean of dust and debris.

CONTAINMENT DESIGN & CONSTRUCTION

Containment is the primary engineering control to prevent patient exposure to contamination. Proper containment design and construction is necessary for proper function. The following sections related to full, negative pressure containments; alternative containment strategies are presented in the next section.

LOCATION

In patient care areas, nurse management must approve the containment location and configuration.

Containment location with respect to emergency egress must be reported to UCDMC Fire Prevention Department. An Interim Life Safety Measure (ILSM) plan may be required.

MATERIALS

Temporary containments shall be constructed of fire-rated polyethylene sheeting (at least 6 mil in thickness) that meets the standards specified by the UCDMC Fire Prevention Department.

Containments to remain in place for extensive periods of time, those requiring additional security or those designed for the control of highly dusty environments, as in the case of abrasive blasting or concrete coring, shall be constructed of rigid, airtight materials, such as drywall and metal wall framing. A hard sided containment with a lockable door shall be used when there are concerns about security or safety from unauthorized entry, especially if the containment will be left unattended for long amounts of time.

Avoid creating tape damage on existing finish materials.

CONSTRUCTION

Locate the HEPA filtered negative pressure unit as far away from the containment entrance (or other location of makeup air) as possible and duct the exhaust outdoors whenever feasible. Distancing the negative pressure unit from the source of makeup air helps to ensure complete and effective scrubbing of the contained airspace. Locating the unit too near the entrance can allow pockets of contamination to exist within the contained zone. At least 4 air changes per hour must be provided within the negative pressure containment at all times.

All sources of air infiltration into the work zone must be sealed off prior to erecting containment barriers. These critical barriers include those over HVAC supply and return registers, electrical outlets, gaps in drop in ceilings, doorways not being used, etc.

All existing surfaces within the containment which are not to be disturbed during the course of construction must be covered with polyethylene sheeting unless they are non-porous, smooth and accessible for cleaning.

Where floors are likely to be damaged by the nature of the construction activities, durable flooring (e.g., plywood, Masonite) shall be installed over two layers of plastic sheeting.

Locate tack mats outside of the containment exit when possible. Otherwise locate tack mats on the floor, just inside the containment exit. An additional tack mat may be useful for especially dusty projects. Expose a new tack sheet when tack mats are no longer sticky and again at the end of each shift.

When required, a manometer, displaying the current containment pressure must be installed in an accessible location near the containment entrance.

NEGATIVE PRESSURE REQUIREMENTS

Negative pressure containments shall be **-**0.02 inches of water column or less (-0.021, -0.022, -0.023….) relative to the adjacent, uncontained space. Exceptions to this requirement may be allowed by IC and will be listed on the ICRA permit.

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.

Pressure which is too negative (-0.060 inches of water column or less) can cause the containment to collapse inwards. To relieve pressure which is too negative, turn down the negative air machines, if possible, and increase the size of the containment door openings.

Manometer Reading	Why it's a problem	Response Options
Positive Pressure (+0.001 and greater)	Active contaminant ejection	This is an emergency. Call Project Manager ASAP!
No pressure (0)	Possible contaminant migration	Close zipper doors, Check and repair breaches, Ensure correct operation of negative air machines, Call Project Manager.
Too Negative (-0. 060 and less)	Could collapse containment	Lift zipper on containment and ante room door

ALTERNATIVE CONTAINMENT STRATEGIES

A full negative pressure enclosure is not always possible or warranted. At times, work may be completed using alternative containment strategies such as those listed below. Other alternative containment strategies may be approved by IC on a case by case basis.

MOBILE CONTAINMENTS AKA "CUBES"

Cubes are manufactured containment systems which are erected on a mobile platform. Examples are pictured on the following page. They are most often used for Class III work and must conform to all Class III ICRA permit requirements, including negative pressure, cleaning, inspection, required postings, etc.

Cubes are not typically inspected at the same frequency of fixed containments as the work is often of short duration and may occur in several locations throughout a single day.

The containment inspector shall conduct periodic, unannounced audits of cube work to ensure compliance with the ICRA and this best practice standard. Inspect cube operations two times or more for each ICRA permit issued. Projects longer than two weeks shall be audited at least twice per month. Where failures are located, corrective action must be taken immediately.

"GLOVE" BAGS OR BOXES & HEPA SHROUDS

Small projects may be accomplished by containing the work only - and not the workers. Glove bags, boxes and HEPA shrouds can be used to complete work which disturbs small areas. Some examples of these systems are pictured on the following page.

Examples of mobile containments or “cubes”

Examples of glove bag/box and HEPA shrouded systems

Projects commonly completed using these types of systems include drilling of small penetrations, cutting in for wire receptacles, and placing backing plates for hanging objects from the wall. Because the containment cannot be posted, display the required postings (including the ICRA permit) in the work area.

Prior to first use, the design and construction of these types of containments shall be approved by IC and EH&S.

The glove bag/box should be composed of a sturdy frame enclosed in polyethylene or a transparent, sturdy material (e.g., plastic panel). Do not use corrugated materials as they tend to collect and retain dust. A tested, HEPA vacuum is used to maintain negative pressure within the glove bag/box. The bag/box must be cleaned prior to detachment.

Negative pressure may be verified by observing the bowing of the bag/box sides, using visible smoke, tissue paper, or other means approved by EH&S.

Work utilizing these types of containments is typically very short in duration and, therefore, inspections differ from those performed in fixed containments. Further, because these types of systems heavily rely on the work practices used, contractors must be strictly monitored, especially at the beginning of a project.

The containment inspector shall conduct periodic, unannounced audits of the work to ensure compliance with the ICRA permit and this best practice standard. Where failures are located, corrective action must be taken immediately and EH&S must be notified immediately.

DEHUMIDIFICATION

Dry out efforts using dehumidifiers is allowed if completed within 72 hours of initial wetting and is approved by EH&S and/or IC. If the duration of the wetting is unknown, additional measures must be performed to ensure no mold growth has occurred – consult with EH&S.

Dehumidification may only be used in cases of clean water or steam condensate intrusion. Materials wetted by contaminated water, black water or grey water require measures beyond dehumidification, ideally removal and replacement.

Dehumidification of voids such as wall or ceiling cavities must be done as a closed loop such that the space does not become positively pressured relative to patient care areas.

POSTINGS

All of the following postings must be maintained in the work area at all times a Class III or IV permitted project is in progress:

- Copy of ICRA Permit
- Copy of Interim Life Safety Measure (ILSM) Permit
- Inspection documentation form (See Appendix A)
- Entry Warning Sign with Project Manager Contact (See Appendix B)
- Staff Education Poster (Appendix C) – Optional after December 2017

CLEANING PROCEDURES

Once all work has been completed within containment, use the following procedures to perform a final cleaning. Final cleaning must be verified and signed off by the containment inspector prior to removing the containment.

1. Change in to a clean disposable suit or clean clothing.
2. Carefully HEPA Vacuum all surfaces. 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.
3. Prepare a measured solution of a UCDMC approved EPA listed disinfectant (see UCDMC Hospital Policy and Procedure 2111) and use according to the instructions on the label.
4. Using clean towels or sponges, wipe all surfaces with the disinfectant. If visible dust accumulates on the applicator, wipe again until no reside is detected. Frequently change to clean applicators.
5. Leave the surface wet and allow to air dry. Do not wipe dry.
6. Remove the top floor layer, if present and HEPA vacuum and wipe down the bottom floor layer.
7. Call for a final visual inspection. The inspection will not be performed until the containment is dry.
    a. If the containment does not pass inspection, the entire containment must be re-cleaned using the steps outlined above prior to re-inspection.
8. When containment passes inspection, remove the components, retain the documents for the project manager, and contact EVS for a terminal cleaning of the project area.

DOCUMENTATION

The project manager shall retain all of the following documents related to the containment:

Copy of ICRA permit

Inspection Documentation Form (see Appendix A) and any Manometer Logs

Copies of HEPA equipment certification

Records of sampling conducted, if any

Findings from project audits

Documents should be retained until project is completed and occupancy has been granted.

CONTAINMENT VERIFICATION

Periodic particle counting is recommended and may be required to ensure exhausted air meets the HEPA rating and ambient air near the project is not excessively loaded with particles, as compared to baseline measurements collected prior to construction or measurements collected in areas deemed currently acceptable. Particle counters should be set to log the collected data and all sampling records must be provided to the project manager and EH&S.

INSPECTION CRITERIA

Inspections are required: at the initial containment setup to verify proper construction, each day to ensure proper operation, once all demolition has been completed, whenever an ICRA reclassification is requested, and when all work has been completed and the containment has been cleaned. The requirements of each of these types of inspections follow.

INITIAL CONTAINMENT INSPECTION (AKA "PRE-START") - EH&S OR CONSULTANT ONLY

To ensure the containment is sufficient prior to the start of work, EH&S or the consultant shall check for the following and sign off on the posted "inspection documentation form" with their name and the date and time the pre-start inspection passed.

- ☐ ILSM permit conditions are met (if applicable)
- ☐ All equipment is free and clear of dust/debris or arrives wrapped in poly
- ☐ Covered cart is available for waste transport
- ☐ HEPA filtered equipment has passed inspection and is not expired
- ☐ Protective clothing is available
- ☐ HVAC is sealed off in work area and other critical barriers are in place
- ☐ Containment is complete (no holes/gaps) and structurally sound
- ☐ Negative pressure exhaust is located as far from containment entry as possible
- ☐ Non-porous, non-cleanable surfaces not in the scope are covered in poly
- ☐ Fixtures outside of the scope of work are covered or removed
- ☐ Where floor damage may occur, durable floor protection is in place
- ☐ Installed manometer displays sufficient negative pressure
- ☐ Negative pressure exhaust is diffused/not directing high velocity air onto occupants
- ☐ All required postings are in place

DAILY INSPECTIONS

Daily containment inspections shall be performed at least once per day. Daily containment checks shall include the following. The containment inspector shall note observations on the "Inspection Documentation Form" (see Appendix A) attached to the containment.

- ☐ ILSM permit conditions are met (if applicable)
- ☐ Containment remains complete (no holes/gaps/tears) and structurally sound
- ☐ No unauthorized personnel are inside
- ☐ All required postings are in place
- ☐ No changes to the location of HEPA exhaust
- ☐ Tack mat is present and usable
- ☐ No signs of track out are observed
- ☐ Installed manometer displays sufficient negative pressure
- ☐ Containment is generally clean
- ☐ Covered carts are being used to transport equipment and wastes
- ☐ All ICRA permit conditions are met

IN-PROGRESS INSPECTIONS (AKA "POST-DEMO")

To ensure completion of the demolition phase of projects, containment inspector shall verify the following conditions and sign off on the containment documentation form with their name and the date and time the inspection was completed.

- ☐ All wetted or hazardous materials have been removed completely

  *May require use of infrared cameras and/or moisture meters

- ☐ Demolition scope is complete
- ☐ No hazardous materials have been discovered
- ☐ Containment is clean and waste has been removed

ICRA CLASS CHANGE (AKA "ICRA DOWNGRADE")

At times, with the approval of IC, construction work may begin under ICRA Permit Class III or IV and become reclassified to Class I or II once major dust producing activities have ceased. An inspection must take place prior to the downgrade to ensure that: the dust producing work is indeed complete, the Class III or IV containment is clean, and the IC requirements of the ICRA permit downgrade are met. For these types of inspections, the containment must meet the criteria for a "final visual inspection" (see next section), with the exception of all construction efforts being complete.

FINAL INSPECTION PRIOR TO DISMANTLEMENT (AKA "FINAL VISUAL")

Once the construction is complete, a containment inspector shall verify the following and document a passing final inspection by signing the inspection log form attached to the containment and including the date and time the inspection passed. Prior to dismantling the containment, the contractor shall collect all posted paperwork, including any manometer tapes, and deliver to the Project Manager, who is responsible for contacting EVS for the terminal cleaning.

- ☐ All construction efforts are completed
- ☐ No tools, equipment or personal belongings are present (clean ladder excepted)
- ☐ No debris or wastes are present
- ☐ Tack mat is clean
- ☐ Containment is "white glove" clean – no visible dust can be wiped from any surface

VII. REFERENCES

The following sources were used to gather information for this policy.

Bartley, J. APIC State-of-the-Art Report: The role of infection control during construction in health care facilities. American Journal of Infection Control, 28(2):156–69.

Clair JD, Colatrella S. Opening Pandora's (tool) Box: health care construction and associated risk for nosocomial infection. Infect Disord Drug Targets. 2013 Jun;13(3):177-83.

Facilities Guideline Institute (2014). *Guidelines for design and construction of hospitals and outpatient facilities.* American Hospital Association.

Grota, P, et. al. (Eds.) (2014) *APIC Text of Infection Control and Epidemiology.* (4th Ed.) Association for Professionals in Infection Control and Epidemiology.

Kanamori H, Rutala WA, Sickbert-Bennett EE, Weber DJ. Review of fungal

outbreaks and infection prevention in healthcare settings during construction and renovation. Clin Infect Dis. 2015 Aug 1;61(3):433-44.

Kidd F, Buttner C, Kressel AB. Construction: a model program for infection control compliance. Am J Infect Control. 2007 Jun;35(5):347-50.

Public Health Agency of Canada. (2001) *Construction-related nosocomial infections in patients in health-care facilities: Decreasing the risk of aspergillus, legionella and other infections.* Ottawa, Ontario: Health Canada.

Rask D, Dziekan B, Swiencicki W, Heinsohn P, Walmsley D. (1998) Air quality control during renovation in health care facilities. In: *Healthy buildings: solutions to global and regional concerns*. Atlanta, GA: ASHRAE Inc Press; 1998.

Sehulster L, Chinn RY. (2003) Guidelines for environmental infection control in health-care facilities. Recommendations of CDC and the Healthcare Infection Control Practices Advisory Committee (HICPAC). Morbidity and Mortality Weekly Report – Recommendations and Reports, 2003, 52(RR-10):1-42.

Sendelbach S, Funk M. Alarm fatigue: a patient safety concern. AACN Adv Crit Care. 2013 Oct-Dec;24(4):378-86.

Vogel R, et. al. (2015). *Infection prevention manual for construction and renovation.* Association for Professionals in Infection Control and Epidemiology.

APPENDIX A: INSPECTION DOCUMENTATION FORM

Initial Information and Benchmark Containment Inspections								
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 Inspection** (Name, Date, Time)	**Take Down Date**

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)	Other Issues? (Explain)	Corrective Actions
Example 7/4/16 0800	B. Clean	-0.025	Y	Y	Y	Y	Y	Y	N	closed entry door

Daily Inspection Log (Continued)

Date	Performed by (Name)	Pressure Reading (+/-)	ILSM conditions still met? (Y/N)	Tack Mat useable? (Y/N)	Postings complete? (Y/N)	HEPA units still in date? (Y/N)	Interior free of dust/debris? (Y/N)	All ICRA conditions met? (Y/N)	Other Issues? (Explain)	Corrective Actions

APPENDIX B: ENTRY WARNING SIGN WITH PROJECT MANAGER CONTACT

Caution

Construction Dust Precautions In Use
Do Not Enter

For More Information Contact the Project Manager

_____

(Name)

_____

Phone Number

This sign must be posted in color

Appendix C: Staff Education Poster

UCDMC Staff Guide for Infection Prevention during Construction

An Infection Control Risk Assessment (ICRA) is a plan created for all construction/renovation projects at the Hospital. The ICRA plan protects patients, visitors and staff from health risks associated with construction dust by requiring specific measures to contain dust and other airborne particles created by construction activities. Negative pressure within the enclosure keeps any generated dust from migrating outside the construction work area. This is the same concept used in the Hospital's negative pressure isolation rooms to isolate patients with airborne contagious diseases such as tuberculosis.

What to Expect

Proper barriers for dust control will be erected to protect patients, visitors and staff from exposure to generated construction dust. Depending on the project, these barriers may be constructed of plastic sheeting or a solid material, such as drywall. Barriers should be full height (floor to ceiling) and tight at wall junctions.

Containments should be posted with the ICRA permit and other signage.

For any problems, contact the project manager immediately

Entryway (Door or Zipper) should remain closed when not being used.
An opening may exist at the base of the entry to allow for make-up air.
This picture represents a breach of practice that should be reported to the project manager.

A sticky mat should be present at the entry (or just inside) to prevent track out of dust/debris.
Contact project manager if any track out or visible dust is observed.

Manometer should be mounted near the entrance and indicate current negative air pressure status within the containment.
Any manometer reading "+" pressure represents a safety hazard. Immediately contact the project manager.

All Equipment and Materials should be transported in covered carts.
Carts without litds can be covered with poly sheeting.

Questions related to the general operation of negative pressure containments may be directed at UCDMC Environmental Health & Safety 916-734-2740

SECTION 0156200
REQUIREMENTS FOR CEILING ACCESS TO SPACES CONTAINING ASBESTOS

PART 1 – PURPOSE

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

PART 2 – POLICY

Work that may disturb asbestos but is not intended to result in intentional asbestos removal shall be controlled in accordance with this section, as well as, Cal/OSHA requirements for Class III asbestos work contained in 8 CCR 1529 and general requirements of 8 CCR 5208. Moving ceiling tiles or horizontal hatches to access ceiling spaces with asbestos 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 3 – PROCEDURES

A. Training

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

B. Competent Person

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

C. Standard Access/Egress Procedures From Mini-enclosure

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

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

3. Proper use of the disposable coveralls and use of the sticky mat shall be followed at all times for all workers and UCDH employees, when it is required by the ICRA Permit. At no time shall workers leave the mini-enclosure wearing soiled disposable coveralls and booties. At times, in select areas requiring sterile environments, it may be necessary to change from soiled disposable clothing into clean disposable clothing before exiting containment. Coveralls and booties are to be removed inside the mini-enclosure and placed into a plastic asbestos waste bag before leaving the mini-enclosure.

D. Air Sampling

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

E. Debris Clean-up

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

F. Personal Protective Equipment

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

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

1. Control of disturbance of asbestos debris during work inside of an attic space with asbestos debris shall be followed in all cases, by using a HEPA vacuum to clean-up visible suspect asbestos containing debris in the immediate area of access and work. If practical, vacuum visible debris for the full path of travel. If this is not practical, use other procedures to ensure safe removal of visible debris in the path of travel that would be disturbed by the crawl. For example, wet paper towels and plastic bags may be used to pick up and contain visible debris. The top surface of the attic access panel shall be cleaned of all dust and debris using a wet paper towel before the access hatch panel is allowed to swing down into the suspended position. Other control methods may be used provided they meet the following criteria:
   - dry sweeping is not permitted
   - employees must not walk on, crawl on or otherwise crush visible suspect asbestos containing debris
   - the control method must not result in a release of airborne fibers.

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

H. HEPA Filter Challenge Testing and Certification

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

I. Access for Inspection after Ceiling Tile has been Removed

Inspection above the ceiling, after a ceiling tile has been moved using a mini-enclosure containment, may be performed with asbestos awareness training. Access of this type is limited to visual inspection through the ceiling opening. Full entry to the space or ceiling crawl must meet the other requirements of this section. Personnel who perform this work must be notified that asbestos is present in the area and of which materials in the area contain asbestos.

J. Asbestos Waste Management

Personnel are required to appropriately bag all asbestos debris, disposable personal protective equipment, and other materials potentially contaminated with asbestos. Bags shall be clear, 6 mil, imprinted with the required asbestos warning label. Appropriate packaging includes double-bagging, and wetting the materials in the inner bag. Each bag shall be legibly marked with (Site address and Generator Number will change with each project site location) The Generator is UCDH. EPA ID No. CAD076124981. The Generator address is 2315 Stockton Blvd., FSSB 2500, Sacramento, CA 95817

For those projects generating five (5) or fewer bags of asbestos-contaminated materials, UCDHS Environmental Health and Safety (EH&S) will manage the disposal of the bags; contact EH&S at 916-734-2740 for disposal with at least one week’s notice of the intent to dispose. Materials must be bagged and marked as described above prior to EH&S’ acceptance.

Asbestos disposal is the responsibility of the Contractor on those projects generating more than five (5) bags of asbestos-contaminated material. If a Uniform Hazardous Waste Manifest is required for transportation, such manifest must be signed by a representative of UCDHS EH&S. Contact EH&S with at least one week’s notice of the intent to dispose.

END OF SECTION 01 56 20

SECTION 016100
PRODUCT REQUIREMENTS

PART 1 - 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 014100 – REGULATORY REQUIREMENTS

C. 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 01450 – QUALITY CONTROL and other Sections in Division 2 through 16 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 or University Standard" 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) days after the date of commencement of the Work specified in the Notice to Proceed, a typewritten list containing 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 thirty-five (35) 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 thirty-five (35) 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 thirty-five (35) 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 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 minimum of four (4) copies.

   b. In reviewing supporting data for substitution, University will use, for purpose of comparison, all characteristics of 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. Furnish list of Subcontractors, if any, that may be affected by the substitution.

4. 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.

5. 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.

6. 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 2 - PRODUCTS – Not Applicable to this Section

PART 3 - 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.

END OF SECTION 01 61 00

REQUEST FOR SUBSTITUTION

Substitution #: _____ **Submittal #:** _____ **Date:** _____

A/C #: _____ **#:** _____

PROJECT NAME: _____

TO: UC DAVIS HEALTH	**FROM:** _____
Facilities Design & Construction	_____
4800 2ND Avenue, Suite 3010	_____
Sacramento, CA 95817	_____
P: 916-734-4436	_____
F: 916-734-7751	_____
Attn.: Ken Pickett	

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 01330 – 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 017200
PREPARATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Surveying and Field Engineering Services

1.02 RELATED SECTIONS

A. Section 014500 – QUALITY CONTROL

1.03 REGISTRATION REQUIREMENT

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

1.04 LINE AND GRADES

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

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

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

PART 2 - PRODUCTS – Not Applicable to this Section

PART 3 - EXECUTION

3.01 INSPECTION

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

3.02 SURVEY REFERENCE POINTS

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

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

3.03 SURVEY REQUIREMENTS

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

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

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

2. Grid or axis for structures.

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

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

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

C. Periodically certify layouts by same means.

3.04 RECORDS

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

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

END OF SECTION 01 72 00

SECTION 017300
CUTTING AND PATCHING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Requirements and limitations for cutting and patching 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 016100 – PRODUCT REQUIREMENTS

E. Individual Specifications Sections.

1. Cutting and patching incidental to Work specified in this Section.

2. Coordination with work in other Sections for openings required to accommodate Work specified in those other Sections.

1.03 SUBMITTALS

A. Contractor shall complete and submit for review to University's Representative, a Coring/Saw cutting 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) 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 A/C number.

2. Location and description of affected Work.

3. Necessity for cutting and patching.

4. Description of proposed work, and products to be used.

5. Alternatives to cutting and patching.

6. Effect on work of University.

7. Written permission of University.

8. Date and time work will be executed.

1.04 NOTIFICATIONS

A. Before starting welding or cutting work involving the use of gas or electric welding equipment, or any brazing work involving gas or electric brazing equipment Contractor shall complete the online Hazardous Conditions Permit form at http://ww.ucdmc.ucdavis.edu/fire. Contractor shall allow seventy-two (72) Hours for Fire Marshal's approval and issuance of Hazardous Conditions Permit. This permit will be issued without cost to Contractor and may be applicable to more than one (1) building. Contractor shall be responsible for reporting to Fire Department either by telephone or in person at beginning and end of each day's work. Provide minimum written notice of fourteen (14) calendar days prior to such activities.

1. Welding and brazing personnel must be certified by a University or OSHPD approved laboratory and must maintain this certification during the work of this Contract.

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

3. Where welding and cutting activity is required and suspect painted surfaces are present that will be impacted by the welding or cutting activity, the contractor shall request from the University’s Representative information regarding laboratory analysis for lead or other hazardous metals in the painted metal components before any cutting or welding is performed. The contractor shall refer to Section 01350 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 2 - PRODUCTS

2.01 MATERIALS

A. Product substitution: For any proposed change in materials, submit request for substitution under provision of SECTION 01610 – PRODUCT REQUIREMENTS.

PART 3 - EXECUTION

3.01 EXAMINATION

A. General: Execute cutting, fitting and patching including excavation and fill, to complete Work and:

1. Fit the several parts together, to integrate with other work.

2. Uncover work to install ill-timed work.

3. Remove and replace defective and non-conforming work.

4. Remove samples of installed work for testing.

5. Provide openings in elements of Work for penetrations of mechanical and electrical work.

B. Examination, General: Inspect existing conditions prior to commencing Work, including elements subject to damage or movement during cutting and patching.

1. After uncovering existing Work, inspect conditions affecting proper accomplishment of Work.

2. Beginning of cutting or patching shall be interpreted to mean that existing conditions were found acceptable by Contractor.

C. Ground Penetrating Radar: Determine by Ground Penetrating Radar all existing reinforcing, conduit and piping located in concrete walls and slabs prior to demolition. Clearly mark all locations and review with University Representative prior to demolition.

3.02 PREPARATION

A. Temporary Supports: Provide supports to assure structural integrity of the Work. Provide devices and methods to protect other portions of Project from damage.

B. Weather Protection: Provide protection from elements in all areas that may be exposed by uncovering work. Maintain excavations free of water.

3.03 CUTTING AND PATCHING

A. Execute cutting, fitting, and patching to properly complete Work.

B. Coordinate installation or application of products for integrated Work.

C. Uncover completed Work as necessary to install or apply products out of sequence.

D. Remove and replace defective or non-conforming Work.

E. Provide openings in the Work for penetrations of mechanical and electrical Work.

3.04 PERFORMANCE

A. Execute cutting and patching by methods to avoid damage to adjoining Work, and that will provide appropriate surfaces to receive final finishing.

B. Execute cutting and patching of weather-exposed, moisture-resistant and sight-exposed surfaces by methods to preserve weather, moisture and visual integrity.

C. Restore work with new Products as specified in individual Sections of Contract Documents.

D. Cut rigid materials using masonry saw or core drill. Pneumatic tools are not allowed without prior approval from University. Coordinate timing of all sawing and cutting work with the University's Representative.

E. Fit work neat and tight allowing for expansion and contraction. Butt new finishes to existing exposed structure, pipes, ducts, conduit, and other penetrations through surfaces.

F. At penetrations of firewalls, partitions, ceiling, or floor construction, completely seal voids with UL approved fire-rated assembly. Provide temporary closures at the end of each work day. Closures shall be approved by the University Fire Marshal.

G. Refinish surface to match adjacent finish. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish unit.

H. Where new construction is to join with or match existing work, it shall be finished exactly to that work so as to form a complete unified and finished element.

END OF SECTION 01 73 00

CORING / SAWCUTTING NOTIFICATION

LOCATION: _____ A/C: _____
TITLE: _____

TRACKING NUMBER:
(Provided by PO&M) _____

OSHPD #: _____ DATE: _____

TO: **Facilities Design & Construction**
UC Davis Medical Center
4800 2nd Avenue, Suite 3010
Sacramento, CA 95817
P: 916-734-4436
F: 916-734-7751

Attn.: Ken Pickett

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: _____

UCDH USE ONLY

DATE RECEIVED:

WHO FROM UCDH 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 017400
CLEANING

PART 1 - 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.

PART 2 - 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 3 - EXECUTION

3.01 CLEANING

A. Construction Cleaning: During Construction, maintain buildings, premises and property free from waste materials and rubbish. Dispose of such waste and debris at reasonable intervals off of University property.

1. Maintain areas under Contractor's control free of waste materials, debris and rubbish. Maintain site in a clean and orderly condition.

2. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to closing such spaces.

3. Clean interior areas daily to provide suitable conditions for Work. Remove debris from areas of work on a daily basis at a minimum, or more often as required to provide suitable conditions for work.

4. Broom clean with sweeping compound or HEPA Vacuum interior areas prior to start of surface finishing, and continue cleaning on as needed basis.

5. Control cleaning operations so that dust and other particles will not adhere to wet or newly-coated surfaces.

6. Provide a mat, as specified above, for project entrances and exits. Item to be of sufficient size to allow personnel exiting project site to clean debris and dust from shoes. Tracking dust and debris through working areas of hospital and/or related buildings is not acceptable. Any dust or debris tracked out of construction site, either by foot traffic or by debris hauling vehicles, at University option, shall be cleaned and removed by Contractor at no additional cost to the University.

B. Conduct cleaning and disposal operations in compliance with all applicable codes, ordinances, regulations, including anti-pollution laws.

3.02 SUBSTANTIAL COMPLETION CLEANING

A. Execute a thorough cleaning prior to Substantial Completion review by University's Representative.

B. Clean walkways, driveways and streets by thorough brooming and wash-down.

C. Clear debris from storm drainage lines and ways, leaving site ready for stormy weather.

D. Rake landscaped areas clean.

E. Remove waste and surplus materials, rubbish and temporary construction facilities, utilities and controls.

F. Disinfect containment and protection areas as directed by University Representative.

G. For Airborne Contamination areas: Construction cleaning use wet cleaning methods and HEPA-filtered vacuum cleaners are required to minimize release of airborne contaminants. Contain waste materials, debris and rubbish.

3.03 FINAL COMPLETION CLEANING

A. Complete final cleaning before submitting final Application for Payment.

B. Employ professional building cleaners to thoroughly clean building immediately prior to final inspection.

C. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign materials from all sight-exposed interior and exterior surfaces.

D. Restore damaged or marred surfaces.

E. Remove dust from all horizontal surfaces not exposed to view, including light fixtures, ledges and fixture lenses.

F. Clean and polish all glass, mirrors, and bright metal work. Clean and disinfect all plumbing fixtures.

G. Damp wash all resilient flooring. Waxing of resilient flooring shall be done by the University.

H. Thoroughly sweep all floors and vacuum all carpets. Cleaning of Work provided by University under separate contracts, will not be required except if soiled by construction activities under this Contract.

I. Thoroughly clean and polish all resilient flooring, metal and plastic surfaces; remove labels and protective coatings.

J. Replace filters and clean heating and ventilating equipment used for temporary heat and ventilation.

K. Remove waste material or equipment that has been damaged, touch up and /or repair exposed areas; such repairs to be approved by University's Representative.

L. Should final cleaning be inadequate, as determined by University's Representative, and Contractor fails to correct conditions, University's Representative may order thorough cleaning and deduct the cost from Final Payment.

3.04 FINAL COMPLETION SITE CLEANING

A. Broom clean exterior paved surfaces. Rake clean other surfaces of the grounds.

B. Hose down and scrub where necessary all concrete and walks dirtied as a result of the construction work. Thoroughly remove mortar droppings from all walks and pavements.

C. Remove from the site all tools, equipment, construction waste, unused materials, excess earth, and all debris resulting from the Work.

3.05 DISPOSAL

A. Conduct cleaning and disposal operations in compliance with all applicable codes, ordinances, regulations, including anti-pollution laws.

B. Do not bury or burn rubbish or waste material on University premises.

C. Do not dispose of volatile wastes, such as mineral spirits, oil, or paint thinner, in storm or sanitary drains.

D. Remove waste materials, debris, and rubbish from site and dispose of off-site.

3.06 INSPECTION

A. Prior to final completion or University use of premises, Contractor and University's Representative shall jointly conduct an inspection of sight-exposed interior and exterior surfaces to verify that entire Work is clean.

END OF SECTION 01 74 00

SECTION 017500
STARTING AND ADJUSTING SYSTEMS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Procedures for Starting Systems

1.02 REALATED SECTIONS

A. Section 018100 – PLUMBING/HVAC TESTING PROCEDURES

B. Section 018200 – DEMONSTRATION AND TRAINING

1.03 SUBMITTAL REQUIREMENTS

A. Submit preliminary schedule listing times and dates for start-up of each item of equipment in sequence in writing, minimum of fourteen (14) calendar days prior to any start-up.

B. Submit manufacturer's representative reports within one (1) week after start-up, listing satisfactory start-up dates.

1.04 PROJECT CONDITIONS

A. Building enclosure shall be complete and weather-tight.

B. Excess packing and shipping bolts shall be removed.

C. Interdependent systems shall have been checked and made operational.

PART 2 - PRODUCTS – Not Applicable to this Section

PART 3 - EXECUTION

3.01 INSPECTION

A. Verify Project conditions comply with requirements for start-up.

B. Verify status of Work meets requirements for starting equipment and systems.

3.02 PREPARATION

A. Coordination: Coordinate sequence for start-up of various item of equipment.

B. Notification: Notify University in writing, minimum of fourteen (14) calendar days prior to start-up of each item of equipment.

C. Information on hand: Have Contract Documents, shop drawings, product data, and operation and maintenance data at hand during entire start-up process.

D. Verify each piece of equipment has been checked for proper lubrication, drive rotation, belt tension, control sequence, and other conditions that may cause damage.

E. Verify control systems are fully operational in automatic mode.

F. Manufacturer's Criteria: Verify tests, meter readings and specific electrical characteristics agree with electrical equipment manufacturers' criteria.

G. Bearings: Inspect for cleanliness: clean and remove foreign matter, verify alignment. Take corrective action as required.

H. Drives: Inspect for tension on belt drives, adjustment of vari-pitch sheaves and drives, alignment, proper equipment speed, and cleanliness. Take corrective action as required.

I. Motors: Verify motor amperage agrees with nameplate value. Inspect for conditions that produce excessive current flow and that exist due to equipment malfunction. Take corrective action as required.

3.03 STARTING SYSTEMS

A. Execute start-up under supervision of responsible Contractor personnel.

B. Place equipment in operation in proper sequence in accordance with sequencing schedule.

END OF SECTION 01 75 00

SECTION 017600
PROTECTING INSTALLED CONSTRUCTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Protection for Products Including University Provided Products, After Installation.

B. Protection of Existing Utilities and Interference.

1.02 RELATED SECTIONS

A. Section 013100 – COORDINATION

B. 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. Electrical Equipment: No work shall be performed on energized electrical equipment unless scheduled with University's Representative. University reserves right to specify specific conditions for all work involving energized high voltage electrical equipment and its scheduled modification proposal.

C. Uncovering Facilities: Prior to any earthwork for new construction, Contractor shall uncover all existing piping where crossings, interferences or connections are shown on Contract Drawings, from one (1) foot below proposed construction limit to the existing ground surface. Any variation in actual elevations and indicated elevations shall be brought to University's Representative attention. If Contractor does not expose all existing utilities, Contractor shall not be entitled to additional compensation for work necessary to avoid unknown interferences.

D. Interferences: If interferences occur at locations other than general locations shown on Contract Drawings, and such utilities are damaged before such locations have been established, or create an interference, Contractor shall immediately notify University's Representative and a method for correcting said interference shall be supplied by University. Payment for additional work due to interferences not shown on Contract Drawings shall be in accordance with the General Conditions of the Contract. Cost of repair to damaged utilities shall be deducted from the Contract Sum.

E. Accuracy of Drawings: Drawings showing location of equipment, piping, etc. are diagrammatic and job conditions will not always permit installations in locations shown.

F. 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 2 - PRODUCTS – Not Applicable to this Section

PART 3 - EXECUTION

3.01 PROTECTION AFTER INSTALLATION

A. Installed Equipment and Materials: Adequately protect all installed equipment and materials until completion and acceptance by University's Representative.

B. Existing Facilities: All existing improvements and facilities shall be protected from damage of any type resulting from operations, equipment or workers of Contractor during the construction process.

C. Subsequent Operations: Protect installed products and control traffic in immediate area to prevent damage from subsequent operations.

D. Traffic Areas: Provide protective coverings at walls, projections, corners, and jambs, sills, and soffits of openings in and adjacent to traffic areas.

E. Elevators: Cover walls and floors of elevator cabs, and jambs of cab doors, when elevators are used by construction personnel.

F. Finished Floors: Protect finished floors and stairs from dirt, wear, and damage:

1. Secure heavy sheet goods or similar protective materials in place, in areas subject to foot traffic.

2. Lay planking or similar rigid materials in place in areas subject to movement of heavy objects and where storage of products will occur.

G. Waterproofed and Roofed Surfaces:

1. Restrict use of surfaces for traffic of any kind, and for storage of products.

2. When an activity is mandatory, obtain recommendations for protection of surfaces from manufacturer. Install protection and remove on completion of activity. Restrict use of adjacent unprotected areas.

H. Lawns and Landscaping: Restrict traffic of any kind across planted lawn and landscaped areas.

I. Adjacent Facilities: Care shall be exercised to prevent damage to adjacent facilities including walks, curbs, and gutters. Planking shall be placed where equipment will pass over such obstructions, and facilities damaged by construction operations shall be

removed and replaced at Contractor's expense.

J. Overloading: Contractor shall be responsible for overloading any part or parts of structures beyond the calculated capacities of the design. Placing materials, equipment, tools, machinery or any other item shall be done with care to avoid overloading. No loads shall be placed on floors or roofs before they have attained their permanent and safe strength.

K. Damaged Work: All damaged work shall be replaced, repaired and restored to its original condition without change to the Contract Sum. Repair or replace all damaged work promptly as directed by University's Representative.

L. Damaged Utilities: Where existing utilities are damaged or disrupted on account of any act, omission, neglect or misconduct of the Contractor in the manner or method of executing the Work, or due to non-execution of work, such damage shall be immediately repaired to maintain operation regardless of the time of occurrence.

M. Temporary Construction: Provide temporary construction necessary for protection of building and its parts. Close in buildings as soon as possible to protect from weather and vandalism. Protect existing buildings and controlled temperature areas from damage.

N. Doors and Casework: Protect doors, millwork and mill counters and cases and hardware from damage, including abrading and scratching of finishes. Protect doors and frames and hardware from mechanical damage and damage to anodic coatings.

O. Protective Coatings: Remove protective coatings, etc., as required to leave work in condition for painting and finishing, final cleaning, etc.

P. Exterior Work: Protect all exterior work, including existing asphalt paving and landscaping and buildings.

END OF SECTION 01 76 00

SECTION 017700
CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Project Closeout Procedures

B. Contract Closeout Procedures

1.02 RELATED SECTIONS

A. Section 013100 – COORDINATION

B. Section 013300 – SHOP DRAWINGS, PRODUCT DATA AND SAMPLES: Administrative general requirements for submittals.

C. Section 015600 – TEMPORARY BARRIERS, ENCLOSURES AND CONTROLS: Removal of Controls.

D. Section 017400 – CLEANING: Final Cleaning.

E. 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. Change building locks from construction to permanent keying, as directed by University's Representative.

D. Complete start-up testing of systems, and instruction of University personnel. Remove temporary facilities from site, along with construction tools, mock-ups, and similar elements.

1.04 SUBSTANTIAL COMPLETION REVIEW

A. Preliminary Punch List Review: At Contractor's request, University's Representative will attend preliminary contract closeout review, not later than fourteen (14) calendar days prior to anticipated Substantial Completion review date.

1. Contractor shall provide at preliminary review a typewritten list (Preliminary Punch List) of items to be completed and corrected.

2. List shall identify items by location (e.g., room number and name) and consecutive number (e.g., 307-5 might identify item 5 in room 307, Roof-4 would identify item 4 on Roof).

3. Segregate architectural, plumbing, HVAC and electrical Work on separate lists.

4. University's Representative and Contractor shall conduct a brief walk-through of Project to review scope and adequacy of list.

B. Contractor's Certification: When determined by Contractor that Work is substantially complete, Contractor shall notify University's Consultant and University's Representative.

1. Submit to University's Representative written certification that:

a. Contract Documents have been reviewed.

b. All portions of Work have been carefully inspected.

c. Work is complete in accordance with Contract Documents.

d. Equipment and systems have been tested, adjusted and balanced and are fully operational.

e. Operation of systems has been demonstrated to University personnel.

f. Work is ready for University's Consultant's Substantial Completion review.

2. Provide minimum seven (7) working days notice to University's Representative prior to desired date for Punch List review.

C. Punch List Review: University's Representative and University's Consultants as may be required, will attend a Contract closeout review and conduct a walk-through of Project to review Contractor's list of items to be completed and corrected (Punch List). Contractor and University's Consultant shall note deficiencies, if any.

1. Contractor shall prepare list and record additional items as University's Representative may determine require completion and correction from walk-through.

a. If deficiencies are noted University's Representative and University's Consultant shall promptly notify Contractor in writing, listing observed deficiencies.

b. If no deficiencies are noted, or when noted deficiencies are removed from the Punch List, University's Representative shall promptly notify Contractor.

2. Contractor shall re-type and distribute list with University's Representative and University's Consultant's additions.

3. Contractor shall remedy deficiencies.

4. Costs of additional visits to site by University's Consultants to review completion and correction of Work shall be deducted from the Contract Sum.

D. Uncorrected Work: Refer to requirements specified in SECTION 01450 – QUALITY CONTROL regarding Contract adjustments for non-conforming work.

E. Cleaning and Clearing: Prior to Substantial Completion review, execute cleaning and clearing site of temporary facilities and controls, as specified in SECTION 01560 – TEMPORARY BARRIERS, ENCLOSURES AND CONTROLS.

F. Testing and Inspection: Prior to Substantial Completion review, complete all tests and inspections and submit applicable reports and approvals.

1. Complete materials tests and inspections.

2. Complete testing, inspection, balancing, sterilization and cleaning of plumbing and HVAC systems.

3. Complete testing and inspection of electrical system.

4. Complete operational tests of equipment.

G. Consultant's Certification: University's Consultant will complete and issue notice of Substantial Completion on American Institute of Architect's Form G704 – CERTIFICATE OF SUBSTANTIAL COMPLETION.

1. Certificate will be completed when University's Consultant determines that list of items to be completed and corrected (Punch List) are sufficiently complete for University to occupy Project for the use intended.

2. University's Consultant will forward copies of completion certification to University and Contractor.

H. Acceptance of the Work shall not relieve Contractor of any responsibility for defects that develop during the guarantee period and are caused by Contractor's failure to perform work in accordance with requirements of Contract Documents.

1.05 FINAL COMPLETION SUBMITALS

A. Evidence of Compliance with Requirements of Governing Authorities:

1. Certificate of Occupancy.

2. Compliance Notification: In conformance with State of California Energy Conservation Standards, Contractor shall, at time of request for final inspection, issue to University's Representative notarized certificate stating completed work appears, in every material respect, to be in compliance with approved Contract Documents. Provide only if specifically required.

B. Final Specifications Submittals: Submit to University's Consultant all documents and products required by Specifications to be submitted, including the Following:

1. Project Record Drawings: Submit under provision of SECTION 01780 – CLOSEOUT SUBMITTALS.

2. Operation and Maintenance Data: Submit under provision of SECTION 01780 – CLOSEOUT SUBMITTALS.

3. Guarantees, Warranties, Bonds, Service and Maintenance Contracts: Submit under provision of SECTION 01780 – CLOSEOUT SUBMITTALS.

4. Spare Parts and Maintenance Materials: Submit under provision of SECTION 01780 – CLOSEOUT SUBMITTALS.

5. Keys and Keying Schedule: At completion of Project, all keys shall be returned to University's Representative. Failure to return a key will obligate Contractor for all costs of re-keying facility.

C. Certificates of Compliance and test Report Submittals: Submit to University's Representative certificates and reports as specified and required, including the following:

1. Sterilization of water system

2. Sanitary sewer system tests

3. Gas system tests

4. Lighting, power and signal system tests

5. HVAC equipment and air balance tests

D. Lien and Bonding Company Releases: Submit to University's Representative, copies of all conditional and unconditional general/subcontractor lien releases showing satisfaction of encumbrances and release of liens of Project by completion and submission of Exhibits of the General Conditions of the Contract, as applicable. Signatures shall be notarized.

E. Subcontractor's List: Submit to University's Representative five (5) copies of updated Subcontractor and Materials Supplier List.

F. Warranty Documents: Prepare and submit to University's Representative all warranties and bonds as specified in SECTION 01780 – CLOSEOUT SUBMITTALS.

1.06 STATEMENT OF ADJUSTMENT OF ACCOUNTS

A. Submit final statement reflecting adjustments to Contract Sum indicating:

1. Original Contract Sum

2. Previous Change Orders

3. Changes under allowances

4. Changes under unit prices

5. Deductions for uncorrected work

6. Penalties

7. Deductions for liquidated damages

8. Deductions for re-inspection fees

9. Other adjustments to Contract Sum

10. Total Contract Sum as adjusted

11. Previous payments

12. Sum remaining due

B. University will issue a final Change Order reflecting approved adjustments to Contract Sum not previously made by Change Order.

1.07 APPLICATION FOR FINAL PAYMENT

A. Final Payment: After completion of all items listed for completion and correction, after submission of all documents and products, and after final cleaning, submit final Application for Payment, identifying total adjusted Contract Sum, previous payments and sum remaining due. Refer to SECTION 01290 – MEASUREMENT AND PAYMENT and the General Conditions of the Contract.

B. Submit Record Documents to University's Representative with final Application for Payment.

1.08 PROJECT AS-BUILT DOCUMENTS

A. Maintain on site, one (1) set of the following as-built documents and record actual construction and all revisions to the Work:

1. Contract Drawings

2. Contract, with Specifications, Addenda, Change Orders, and modifications to the Contract.

3. Approved shop drawings, product data and samples.

4. Store As-built Documents separate from documents used for construction.

B. Drawings: Record information continuously as Work progresses. Do not conceal Work permanently until required information is recorded.

C. Specifications: In PART 2 – PRODUCTS in each Section, legibly mark and record actual Products installed or used, including:

1. Manufacturer, trade name, product model or catalog number and supplier of each product or item of equipment installed.

2. Product substitutions or alterations utilized.

3. Changes made by Addenda, Modification, Change Order, Field Order, and clarifications or interpretations made by Letter of Instruction.

D. As-built Drawings: Keep up to date during entire progress of the Work and make available to University at any time. Recording of the As-built condition shall be carefully and neatly done by a competent drafter, familiar with the trade involved, using methods acceptable to University's Representative. Legibly and to scale, mark a reproducible set of Contract Drawings to record all changes in size, location, and other features of installation in the actual construction, including:

1. Measured depths of foundations and footings encountered, measured in relationship to finish First Floor datum.

2. Measured horizontal and vertical locations of underground utilities and appurtenances referenced to permanent ground improvements.

   a. Locations of work buried under or outside building footprint, such as plumbing and electrical lines and conduits.

   b. Record all locations of underground work, points of connection, valve locations, manholes, catch basins, capped stub-outs, invert elevations, etc.

3. Field changes of dimension and detail.

   a. Locations of all significant work concealed inside building, the locations of which are changed by Contractor from those shown on Contract Drawings.

   b. Locations of all items, not necessarily concealed, which vary from locations shown on the Contract Drawings.

   c. Record sufficient information so that concealed work may be located with reasonable ease and accuracy.

4. Actual numbering of each electrical circuit.

5. Details not on original Contract Drawings.

6. Additional drawings as required to properly describe changes.

7. Reproducible set of Contract Drawings will be provided to Contractor by University's Representative.

E. Shop Drawings: Provide reproducible Record copy, made from final Shop Drawings, updated to show actual conditions for work specified in individual Sections.

F. Large Scale Drawings: Divisions 23 and 26 of the Contract Specifications require preparation of large-scale, detailed layout drawings for the work of those Divisions. These layout drawings are not shop drawings as defined by the General Conditions of the Contract but together with Shop Drawings or layout drawings of all other affected sections, are used to check, coordinate and integrate the Work of the Various Sections.

Maintain and submit these layout drawings as part of the Project Record Drawings.

G. Acceptance: All Record Documents are subject to review and acceptance by University.

PART 2 - PRODUCTS – Not Applicable to this Section

PART 3 - EXECUTION – Not Applicable to this Section

END OF SECTION 01 77 00

SECTION 017800
CLOSEOUT SUBMITTALS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Equipment Data

B. Operation and Maintenance Instructions

C. Instruction of UCDH personnel

D. Schedule of Submittals

E. Spare Parts and Maintenance Materials

F. Guarantees, Warranties, Bonds, Service and Maintenance Contracts

G. Project As-built Documents

1.02 RELATED SECTIONS

A. Section 013100 – COORDINATION

B. Section 013300 – SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

C. Administrative general requirements for submittals.

D. Section 014500 – QUALITY CONTROL: Manufacturer's tests and inspections as a condition of warranty.

E. Section 016100 – PRODUCT REQUIREMENTS

F. Section 017700 – CLOSEOUT PROCEDURES

1.03 EQUIPMENT DATA AND OPERATION AND MAINTENANCE INSTRUCTIONS

A. Preparation of data shall be done by persons:

1. Trained and experienced in maintenance and operation of described products.

2. Familiar with requirements of this Section.

3. Skilled in technical writing to extent required for communication of essential data.

4. Skilled as drafters competent to prepare required drawings

B. Equipment Manual Format: Prepare in the form of a data and instructional manual.

1. Binders: Commercial quality, 8-½" x 11", three-ring binders with hardback, cleanable, plastic covers; 1" minimum, 1-½" maximum ring size. Provide separate binders, submitted separately for each discipline, i.e. Site Work, Doors and Windows, Conveying Systems, Mechanical, Plumbing, Electrical, etc. Correlate data into related consistent groupings. Provide two (2) copies of data in Adobe PDF format on CD as well.

2. Cover: Identify each binder with typed or printed title "EQUIPMENT DATA AND OPERATION AND MAINTENANCE INSTRUCTIONS".

   a. List Project title and Project number and particular building as applicable.

   b. Identify contents.

3. Organization: Arrange content by systems under Section numbers and sequence in accordance with the Project Specifications Table of Contents. Provide tabbed flyleaf for each separate product and system with typed description of product and major component parts of equipment.

4. Text: Manufacturer's printed data or typewritten data on 20 pound paper.

5. Drawings: Provide with reinforced punched binder tabs. Bind in with text; fold larger drawings to size of text page. Do not hole punch drawings. Insert drawings in clear plastic holder.

C. Table of Contents, Each Volume: Provide title of Project, 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 Record Documents as maintenance drawings.

4. Additional Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in SECTION 01450 – QUALITY CONTROL.

5. Warranties and Bonds: Bind in copy of each.

D. Manual for Materials and Finishes:

1. Building Products, applied Materials, and Finishes: Include product data, with catalog number, size, composition, and color and texture designations. Provide information for re-ordering custom manufactured Products.

2. Instruction for Care and Maintenance: Include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

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 a listing in Table of Contents for design data, with tabbed binder divider page and space for insertion of data.

E. Manual For Equipment And Systems

1. Record Instructions: Forward to University's Representative, upon completion of work, and before work will be considered for acceptance, complete bound sets of instructions of entire plant and component parts, including manufacturer's certificates, warranty slips, parts lists, descriptive brochures, and maintenance and operating instructions, in quantities set forth in various Divisions. Print information on heavy white paper, tab properly and identify for each reference. Submit drafts for review before preparing final sets, six (6) copies required.

2. O & M Instructions: Provide and install, where directed, printed sheet under clear plastic cover, giving concise operating and maintenance instruction for equipment.

3. Each Item of Equipment and Each System: Inclusive description of unit or system, Model Number, Serial Number, and component parts. Identify function, normal characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts. Best to include all information provided in final approved equipment submittal. Design drawing data may not reflect what was actually provided.

4. Panelboard Circuit Directories: Provide electrical service characteristics, controls and communications.

5. Wiring Diagrams: Include color-coded wiring diagrams as installed.

6. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shutdown, and emergency instructions. Include summer, winter, and any special operating instructions.

7. Maintenance Requirements: Include routine procedures and guide for trouble-shooting; disassembly, repair, and re-assembly instructions; and alignment, adjusting, balancing, and checking instructions. Provide servicing and lubrication schedules, and list of lubricants required.

8. Instructions: Include manufacturer's printed operation and maintenance instructions. Include sequence of operation by controls manufacturer.

9. Parts Data: Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

10. Control Data: Provide as installed control diagrams by controls manufacturer.

11. Piping Data: Provide Contractor's coordination drawings, with color piping diagrams as installed. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

12. Design Data: Provide a listing in table of Contents for design data, with tabbed binder divider page and space for insertion of data.

13. Reports: Include test and balancing reports as specified in SECTION 01810 – TESTING, ADJUSTING AND BALANCING PROCEDURES.

14. Additional Requirements: As specified in individual Specification Sections.

F. Instruction of University's Personnel: Instruct University designated personnel to their full and complete understanding, procedures necessary to operate and maintain equipment and systems on continuing basis. Provide training of staff.

1. Schedule: Before final inspection, instruct University designated personnel in operation, adjustment, and maintenance of products, equipment, and systems, at agreed upon times. For equipment requiring seasonal operation, perform instructions for other seasons within six (6) months of completion.

2. Basis of Information: Use operation and maintenance manuals as basis for instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.

3. Instructional Material: Prepare and insert additional data in the manual when need for such data becomes apparent during instruction.

G. Equipment Data and Operation and Maintenance Instructions Submittals:

1. Submittals: Comply with administrative requirements specified in SECTION 01330 – SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.

2. Preliminary Draft Submittal: Submit two (2) copies of preliminary draft or proposed formats and outlines of contents no later than ten (10) days of equipment submittals approval. University's Representative will review draft and return one (1) copy with comments.

3. Advance Submittals: For equipment, or component parts of equipment to be put into service during construction and operated by University, submit documents within ten (10) calendar days after equipment approval.

4. Final Submittal: After completion of instruction of University operation and maintenance personnel and final inspection, revise content of documents to include additional information deemed necessary from instruction experience of University's personnel and any changes made during construction. Submit three (3) copies of completed volumes in final form a minimum of ten (10) calendar days after final inspection.

1.04 SPARE PARTS AND MAINTENANCE MATERIALS

A. Products Required: Where called for in Contract Specifications, deliver to University's Representative, materials, etc., for use in maintenance work. Provide list of materials delivered to University's Representative, indicating date and acceptance by University's Representative.

1. Provide quantities of products, spare parts, maintenance tools, and maintenance materials specified in individual Sections to be provided to University's Representative, in addition to that required for completion of the Work.

2. Products supplied shall be identical to those installed in the Work. Include quantities in original purchase from supplier to avoid variations in manufacture.

B. Storage, maintenance: Store products with products to be installed in the Work, as specified in SECTION 01610 – PRODUCT REQUIREMENTS: Product Storage and Protection.

C. Delivery to site: Prior to final payment, deliver and unload spare products to project site. Coordinate with University's Representative and obtain receipt. University will handle and store products.

1.05 WARRANTIES AND GUARANTEES

A. Warranties and Guarantees, general: Guarantees from subcontractors shall not limit Contractor's warranties and guarantees. Whenever possible, Contractor shall cause warranties of subcontractors to be made directly to University. If such warranties are made to Contractor, Contractor shall assign such warranties to University prior to final payment. When equipment and products, or components thereof, bear a manufacturer's warranty or guarantee that extends the time period of Contractor's warranty or guarantee, so state in the warranty or guarantee.

1. Standard Product Warranties: Preprinted written warranties published by individual manufacturers for particular products and specifically endorsed by manufacturer to University.

2. Special Warranties: Written warranties required by or incorporated in Contract Documents, to extend time limits provided by standard warranties or to provide greater rights for University.

3. Provisions for Special Warranties: Refer to General Conditions of the Contract for terms of Contractor's special warranty of workmanship and materials.

4. Specific Warranty Requirements: requirements are included in the individual Sections of Division 2 through 16 of the Contract Specifications, including content and limitations

5. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of warranty on work that incorporates the products, nor does it relieve suppliers, manufacturers, and subcontractors requirement to countersign special warranties with Contractor.

6. Related Damages and Losses: When correcting warranted work that has failed, remove and replace other work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted work.

7. Reinstatement of Warranty: When work covered by a warranty has failed and been corrected, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to original warranty with an equitable adjustment for depreciation.

8. Replacement Cost: On determination that work covered by a warranty has failed, replace or rebuild the work to an acceptable condition complying with requirements of Contract Documents. Contractor shall be responsible for cost of replacing or rebuilding defective work regardless of whether University has benefited from use of the work through part of its useful service life.

9. UCDH Recourse: Written warranties made to University are in addition to implied warranties, and shall not limit duties, obligations, right and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which University can enforce such other duties, obligations, rights, or remedies.

10. Rejection of Warranties: University reserves right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Contract Documents.

11. University reserves right to refuse to accept work where a special warranty, or similar commitment is required, until evidence is presented that entities required to countersign commitments are willing to do so.

12. When designated portion of Work is completed and occupied or used by separate agreement with Contractor during the construction period, submit properly executed warranties to University's Representative within fourteen (14) calendar days of completion of that designated portion of the Work.

13. Submit written guarantees, in the form contained at end of this Section.

B. Form of Warranty or Guarantee: All written warranties and guarantees, excepting manufacturers' standard printed warranties and guarantees, shall be submitted on Contractor's, subcontractor's, material supplier's, or manufacturer's own letterhead, addressed to University. Warranties and guarantees shall be submitted in duplicate, and complying with the form letter following. Warranty and guarantee letters shall be signed by all responsible parties and by Contractor in every case, with modifications only as approved by University to suit the conditions pertaining to the warranty or guarantee.

C. Submission requirements:

1. Contractor shall collect and assemble required warranties, guarantees, bonds, and service and maintenance contracts. Provide two (2) original signed copies of each.

2. Table of Contents: Neatly typed and in orderly sequence, provide complete information for each items as follows:

   a. Product or Work item.

   b. Product or work suppliers firm name, address, telephone number and name of principal.

   c. Scope of guarantee, bond, service or maintenance agreement.

   d. Date of beginning of guarantee, bond, service or maintenance contract.

   e. Duration of guarantee, bond, service or maintenance contract.

   f. Contractor's name, address, telephone number and name of principal.

   g. Provide information for University personnel:

      1) Proper procedure in case of failure.

      2) Circumstances that might affect validity of guarantee or bond.

D. Form of Submittal: Prepare in duplicate packets.

1. Size: 8-½" x 11" sheets punched for 3-ring binder. Fold larger sheets to fit into binders.

2. Identify each packet on cover with typed or printed title, "GUARANTEE AND BONDS", and the following:

   a. Title of Project

   b. Project Number

   c. Name of Contractor

3. Binders: Commercial quality, 3-ring, with durable and cleanable plastic covers.

E. Time of Submittals: Submit within ten (10) calendar days of Substantial Completion, prior to request for final payment. When work activity is delayed materially beyond date of Substantial Completion, provide updated submittal within ten (10) calendar days after Final Completion, listing date of Final Completion as the start of the Guarantee period.

F. Submittals Required: Submit guarantees, bonds, service or maintenance contracts specified in individual Sections of the Specifications.

1. Contractor shall collect and assemble all written warranties and guarantees into a binder.

2. Submit all required Warranties and Guarantees on letterhead of Contractor.

1.06 **PROJECT RECORD DOCUMENTS**

A. Maintenance of Record Documents and Samples:

1. Provide complete set of Record Drawings and Specifications, showing every change from original Contract set, including all Addenda, Change Order, job decisions, etc. Prints for this purpose may be obtained from University's Representative.

2. When work is complete and prior to final payment, submit one (1) complete set of all record documents, marked to show any deviation from the original Contract set. These documents are to be an accurate description of all work as-built.

3. Prior to Application for final payment, a set of drawings shall be obtained from University's Representative and all changes, as noted on the Record Drawings shall be incorporated thereon. The set of drawings, together with one (1) copy therefrom, shall be delivered to University's Representative.

4. Label and file record Documents and samples in accordance with Section number listings in the Project Specifications Table of Contents. Label each document "PROJECT AS-BUILT" in neat, large, printed letters. Each document and sample shall include the University's Project title and Project number for reference purposes.

5. Maintain Record Documents in a clean dry and legible condition. Do not use Record Documents for construction purposes. Keep record Documents and samples available for inspection by University.

6. Record Schedule: Contractor shall provide Record Schedule of construction activities. Schedule shall be in same format as specified in SECTION 01320 – CONTRACT SCHEDULES.

B. Submittals: At Contract closeout, deliver Record Documents and samples as required by SECTION 01770 – CLOSEOUT PROCEDURES.

1. Transmit with cover letter in duplicate, 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.

PART 2 - PRODUCTS – Not Applicable to this Section

PART 3 - EXECUTION – Not Applicable to this Section

END OF SECTION 01 78 00

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: _____

REPORT OF WORK REQUIRED BY WARRANTY

To:	Ken Pickett, University Representative
From:	

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

Prepared by: _____ _____ _____

(Print Name) Signature Date

In accordance with the terms and conditions of the Contract, the Contractor has agreed that, if at any time within _____ months after the date of the guarantee the Contractor receives notice from University that the aforesaid portion of the Work is unsatisfactory, faulty, deficient, incomplete, or not in conformance with the requirements of the Contract, the Contractor will, within 10 days after receipt of such notice, correct, repair, or replace such portion of the Work, together with any other parts of the Work and any other property which is damaged or destroyed as a result of such defective portion of the Work or the correction, repair, or replacement thereof; and that it shall diligently and continuously prosecute such correction, repair, or replacement to completion.

Prompt notification to be provided by the University Representative to the appropriate Contractor.

SECTION 018100
PLUMBING/HVAC TESTING PROCEDURES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Procedures for Adjusting and Balancing Systems

1.02 RELATED SECTIONS

A. Section 014500 – QUALITY CONTROL: Testing organization services.

B. Section 017500 – STARTING, AND ADJUSTING SYSTEMS: Starting and adjusting equipment prior to commissioning.

C. Section 158900 – DUCTWORK: Testing.

D. Section 159900 – PLUMBING/HVAC FINAL TESTING, ADJUSTING & BALANCE

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

1.03 SUBMITTAL REQUIREMENTS

A. Service Provider: Prior to start of work, submit name or organization proposed to perform services. Designate managerial responsibilities for coordination of all testing activities.

B. Qualifications: Submit documentation to confirm organization qualifications.

C. Report Forms: Submit three (3) preliminary specimen copies of each report form proposed for use.

D. Final Report Submission: Fourteen (14) calendar days prior to completion submit three (3) copies of final reports. Submit reports of testing that are postponed due to seasonal, climatic, occupancy, or other reasons beyond Contractor’s control, promptly after execution of those services.

1.04 GENERAL PROCEDURES

A. Procedural Compliance: Comply with procedural standards of certifying association under whose standard services will be performed.

B. Notification: Notify University's Representative, in writing, minimum of fourteen (14) calendar days prior to beginning service operation.

1. Record Keeping: Accurately record date for each step.

2. Report to University’s Representative any defects or deficiencies noted during performances of services.

1.05 CONTRACTOR RESPONSIBILITIES

A. Prepare each system for testing.

B. Coordinate with testing organization; provide access to equipment and systems. Operate systems at designated times, and under conditions required for proper testing.

C. Notify testing organization fourteen (14) calendar days prior to time system will be ready for testing.

1.06 FINAL REPORTS

A. Organization having managerial responsibility shall make reports.

B. Each Form shall bear signature of recorder, and that of supervisor of reporting organization.

C. Identify each instrument used and latest date of calibration of each.

PART 2 - PRODUCTS – Not Applicable to this Section

PART 3 - EXECUTION

3.01 PREPARATION

A. Provide instruments required for testing operations. Make instruments available to University to facilitate spot checks during testing. Retain possession of instruments and remove at completion of services.

B. Verify installation of system to be tested is complete and in continuous operation.

C. Verify ambient conditions and related facilities are in full operation.

3.02 SCHEDULE OF SYSTEMS REQUIRING TESTING SERVICES

A. Test piping at completion of roughing in, in accordance with the following schedule and show no loss in pressure or visible leaks after minimum duration under water pressure as set forth:

TEST SCHEDULE SYSTEM TESTED	TEST PRESSURE PSIG	DURATION
All Soil, Waste Drain and Vent Piping, and All Storm Drains	Test with water to top of highest vent, minimum of 10'.	2 Hours
All Underground Soil, Waste Drain, Vent Piping and Storm Drain Piping	5 psig - *Air	15 Minutes
Heating and Chilled Water Distribution System Connections	225 psig	4 Hours
Domestic Hot & Cold Water Piping	150 psig at rough in	2 Hours
Low Pressure Steam And Condensate	150 psig	2 Hours
High Pressure Steam	50% above Design Operation Pressure	4 Hours
Fire Sprinkler Piping Water	200 psig	2 Hours
Ductwork	See Section 15890 for testing requirements	

The air test shall be made by attaching an air compressor testing apparatus to any suitable opening, and after closing all other inlets and outlets to the system, forcing air into the system until there is a uniform gage pressure.

B. Testing equipment, materials, and labor shall be furnished by Contractor.

C. Repair piping systems sections which fail required piping test, by disassembly and reinstallation, using new materials to extent required to overcome leakage. Do not use chemicals, stop-leak compounds, mastics, or other temporary repair methods.

END OF SECTION 01 81 00

SECTION 018200
DEMONSTRATION AND TRAINING

PART 1 - 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 fourteen (14) calendar day prior to activities.

B. Submit reports within (1) week after completion of demonstrations, that demonstrations and instructions have been satisfactorily completed. Give time and date of each demonstration, and hours devoted to demonstration with a list of persons present.

1.04 QUALITY ASSURANCE

A. Equipment installed under Contract shall operate quietly and free of vibration. Adjust, repair, balance properly, or replace equipment producing objectionable noise or vibration in occupied areas of building. Provide additional brackets, bracing, etc., to prevent such noise or vibration. Systems shall operate without humming, surging or rapid cycling.

B. University will provide list of personnel to receive instructions, and will coordinate their attendance at agreed-upon time.

PART 2 - PRODUCTS – Not Applicable to this Section

PART 3 - EXECUTION

3.01 PREPARATION

A. Verify equipment has been inspected and put into operation.

B. Have copies of completed operation and maintenance manual at hand for use in demonstration instructions.

3.02 DEMONSTRATION AND INSTRUCTIONS

A. Demonstrate operation and maintenance of equipment and systems to University two (2) weeks prior to date of final inspection. For equipment requiring seasonal operation,

perform instructions for other seasons within six (6) months of completion.

B. Use operation and maintenance manuals as basis of instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.

C. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at scheduled times, at equipment location.

D. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

END OF SECTION 01 82 00

SECTION 024120
SELECTIVE DEMOLITION

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Demolition and removal of selected portions of building or structure.
   2. Salvage of existing items to be reused or recycled.

1.2 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Salvage: Detach items from existing construction and deliver them to Owner ready for reuse.

C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.

D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.3 SUBMITTALS

A. Schedule of Selective Demolition Activities: Indicate the following:
   1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
   2. Interruption of utility services. Indicate how long utility services will be interrupted.
   3. Coordination for shutoff, capping, and continuation of utility services.
   4. Use of elevator and stairs.
   5. Locations of proposed dust- and noise-control temporary partitions and means of egress.
   6. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
   7. Means of protection for items to remain and items in path of waste removal from building.

B. Inventory: After selective demolition is complete, submit a list of items that have been removed and salvaged.

1.4 QUALITY ASSURANCE

A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.

B. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

C. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

D. Standards: Comply with ANSI A10.6 and NFPA 241.

E. Pre-Demolition Conference: Conduct conference at Project site to review methods and procedures related to selective demolition including, but not limited to, the following:
   1. Inspect and discuss condition of construction to be selectively demolished.
   2. Review structural load limitations of existing structure.
   3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
   4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
   5. Review areas where existing construction is to remain and requires protection.

1.5 PROJECT CONDITIONS

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
   1. Comply with requirements specified in Division 1 Section "Summary."

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
   1. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Owner will remove hazardous materials under a separate contract.

E. Storage or sale of removed items or materials on-site is not permitted.

F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
   1. Maintain fire-protection facilities in service during selective demolition operations.

1.6 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped.

B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.

D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

E. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems: Maintain services/systems indicated to remain and protect them against damage during selective demolition operations.
   1. Comply with requirements for existing services/systems interruptions specified in Division 1 Section "Summary."

B. Service/System Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
   1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
   2. Arrange to shut off indicated utilities with utility companies.
   3. If services/systems are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
   4. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.
      a. Where entire wall is to be removed, existing services/systems may be removed with removal of the wall.

3.3 PREPARATION

A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
   1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
   2. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
   3. Cover and protect furniture, furnishings, and equipment that have not been removed.

C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
   1. Strengthen or add new supports when required during progress of selective demolition.

3.4 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
   1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.

2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
5. Maintain adequate ventilation when using cutting torches.
6. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
7. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
8. Dispose of demolished items and materials promptly.

B. Removed and Salvaged Items:
1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

C. Removed and Reinstalled Items:
1. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals, using power-driven saw, then remove concrete between saw cuts. Neatly trim openings to dimensions indicated.

B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.

C. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI-WP and its Addendum.
1. Remove residual adhesive and prepare substrate for new floor coverings by one of the methods recommended by RFCI.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be recycled**,** reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

B. Burning: Do not burn demolished materials.

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

3.7 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION

SECTION 024126
SELECTIVE ELECTRICAL DEMOLITION

1.1 - GENERAL

2.0 SUMMARY

1. Section Includes:
   a. Removal of existing electrical equipment, wiring, and conduit in areas to be remodeled; removal of designated construction; dismantling, cutting and alterations for completion of the Work.
   b. Disposal of materials.
   c. Storage of removed materials.
   d. Identification of utilities.
   e. Salvaged items.
   f. Protection of items to remain.
   g. Relocate existing equipment to accommodate construction.

2.1 SCHEDULING

1. Schedule work to coincide with new construction.
2. Cease operations immediately when structure appears to be in danger and notify Architect/Engineer. Do not resume operations until directed.

2.2 COORDINATION

1. Conduct demolition to minimize interference with adjacent [and occupied] building areas.
2. Coordinate demolition work with Owner.
3. Coordinate and sequence demolition so as not to cause shutdown of operation of surrounding areas.
4. Shut-down Periods:
   1. Arrange timing of shut-down periods of in-service panels with Owner. Do not shut down any utility without prior written approval.
   2. Keep shut-down period to minimum or use intermittent period as directed by Owner. Maintain life-safety systems in full operation in occupied facilities or provide notice minimum 3 days in advance.
5. Identify salvage items in cooperation with Owner.

1.2 - PRODUCTS

Not Used

1.3 - EXECUTION

A. EXAMINATION

1. Verify existing conditions before starting work.
2. Verify wiring and equipment indicated to be demolished serve only abandoned facilities.
3. Verify termination points for demolished services.

B. PREPARATION

1. Erect, and maintain temporary safeguards, including warning signs and lights, barricades, and similar measures, for protection of the public, Owner, Contractor’s employees, and existing improvements to remain.
2. Existing Fire Alarm System: Maintain existing system in service. Disable system only to make switchovers and connections. Make temporary connections to maintain service in areas adjacent to work area.

3. Existing Telephone System: Maintain existing system in service.
4. Existing Public Address System: Maintain existing system in service. Disable system only to make switchovers and connections. Make temporary connections to maintain service in areas adjacent to work area.

C. DEMOLITION

1. Demolition Drawings are based on field observation and existing record documents. Report discrepancies to Architect before disturbing existing installation.
2. Contractor shall visit project site and verify all conditions as they exist and shall remove, relocate and/or rework any electrical equipment or circuits affected (whether indicated or not) due to removal of existing walls, ceilings, etc. Coordinate all work with other trades.
3. Remove abandoned conduit, cabling, and associated supports, including abandoned conduit and cables above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces to match existing.
4. Remove conduit, wire, boxes, and fastening devices to avoid any interference with new installation.
5. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.
6. Remaining Circuits and Equipment: Reinstall existing electrical installations disturbed. Certain existing electrical installations may be located in walls, ceilings or floors that are to be removed and are essential for the operation of other remaining installations. Where this condition occurs provide a new extension of original circuits, raceways, equipment, and outlets to retain service continuity. Installations shall be concealed in finished areas.
7. Reconnect equipment being disturbed by renovation work and required for continuous service.
8. Disconnect or shut off service to areas where electrical work is to be removed. Remove electrical fixtures, equipment, and related switches, outlets, conduit and wiring which are not part of final project.
9. Install temporary wiring and connections to maintain existing systems in service during construction.
10. Perform work on energized equipment or circuits with experienced and trained personnel.
11. Remove, relocate, and extend existing installations to accommodate new construction.
12. Repair adjacent construction and finishes damaged during demolition and extension work.
13. Remove exposed abandoned grounding and bonding components, fasteners and supports, and electrical identification components, including abandoned components above accessible ceiling finishes. Cut embedded support elements flush with walls and floors.
14. Clean and repair existing equipment to remain or to be reinstalled.
15. Protect and retain power to existing active equipment remaining.
16. Cap abandoned empty conduit at both ends.
17. If removed devices are on walls or ceilings that are to remain, blank cover plates are to be installed on outlet boxes.

D. EXISTING PANELBOARDS

1. Ring out circuits in existing panel affected by the Work. Where additional circuits are needed, reuse circuits available for reuse. Install new breakers.
2. Tag unused circuits as spare.
3. Where existing circuits are indicated to be reused, use sensing measuring devices to verify circuits feeding Project area or are not in use.
4. Remove existing wire no longer in use from panel to equipment.
5. Provide new updated directories where more than three circuits have been modified or rewired.

E. SALVAGE ITEMS

1. Remove and protect items indicated on Drawings to be salvaged and turn over to Owner.
2. Items of salvageable value may be removed as work progresses. Transport salvaged items from site as they are removed.

F. REUSABLE ELECTRICAL EQUIPMENT

1. Carefully remove equipment, materials, or fixtures which are to be reused.
2. Disconnect, remove, or relocate existing electrical material and equipment interfering with new installation.

G. CLEANING

1. Remove demolished materials as work progresses. Legally dispose.
2. Keep workplace neat.
3. Clean and repair existing materials and equipment which remain or are to be reused.
4. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.

H. RECYCLABLE AND REUSABLE MATERIAL AND EQUIPMENT:

1. Contractor shall be responsible for recycling of all removed materials and equipment as part of this work. Materials shall be collected by a recognized and approved reuse and recycling center.
2. Recyclable and reusable material and equipment shall include but not limited to the following:
   a. Plastic lighting diffusers
   b. Ferrous metals
   c. Non-ferrous metals
   d. Fluorescent lamps and ballasts

I. PROTECTION OF FINISHED WORK

1. Do not permit traffic over unprotected floor surface.

END OF SECTION

SECTION 055000
METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Metal fabrications for applications where metal fabrications are not specified in other Sections.

B. Related Sections:
   1. Section 099000 - Painting: Finish field painting (PT).

1.2 COORDINATION

A. Coordinate installation of anchorages for metal fabrications. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.3 QUALITY ASSURANCE

A. Fabricator Qualifications: Firm experienced in producing metal fabrications similar to those indicated for this Project and with record of successful in-service performance, as well as sufficient production capacity to product required units.

B. Installer Qualifications: Arrange for metal fabrications specified in this Section to be fabricated and installed by same firm.

C. Welding: Qualify procedures and personnel according to AWS D1.1, “Structural Welding Code--Steel,” and AWS D1.3, “Structural Welding Code-Sheet Steel.”

1.4 HANDLING AND STORAGE

A. Load, unload, handle and store work in manner that will not bend, deform or otherwise damage metal. Store so metal and shop coats will not be subject to weather or moisture, store off ground and provide covering for metal in storage.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
   1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 MATERIALS

A. Materials, General:
   1. Metal Surfaces: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel:
   1. Rolled-Steel Floor Plate: ASTM A 786 rolled from plate complying with ASTM A 36 or ASTM A 283, Grade C or D.
   2. Sections, Plates, Sheet and Bars: Structural quality steel; ASTM A36 and ASTM A440 where high strength steel is required.
   3. Steel Plates, Shapes and Bars: ASTM A36.
   4. Steel Tubing: ASTM A501 or ASTM A500.
   5. Steel Pipe: ASTM A53, Type S, Grade A, standard weight and extra-strong as required, galvanized and plain.
   6. Galvanized Sheet Metal: ASTM A526 or A527, G-90 coating designation with both sides of metal prime painted.
   7. Galvanizing: ASTM A123, hot dip galvanizing, thickness Grade 55 unless otherwise indicated.

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

D. Fasteners: Provide zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 25 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required
   1. Bolts, Nuts and Washers: High strength steel hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563; and, where indicated, flat washers.
   2. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, load equal to 6 times load imposed when installed in unit masonry and equal to 4 times load imposed when installed in concrete, as determined by testing per ASTM E488, conducted by qualified independent testing agency.
      a. Material: Carbon-steel components zinc-plated to comply with ASTM B633, Class Fe/Zn 5.
   3. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47 malleable iron or ASTM A 27 cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329

2.3 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
   1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

J. Miscellaneous Framing and Supports: Fabricate from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
   1. Fabricate units from slotted channel framing where indicated.
   2. Furnish inserts for units installed after concrete is placed.

2.4 FINISHING

A. Comply with NAAMM'S "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
   1. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.

B. Galvanizing: Hot-dip galvanize items as indicated to comply with applicable standard listed below:
   1. Hot Dip Galvanizing for Shapes and Plates: ASTM A123, for galvanizing both fabricated and unfabricated iron and steel products made of uncoated rolled, pressed, and forged shapes, plates, bars, and strips 0.0299 inch thick and heavier.
   2. Hot Dip Galvanizing for Bolts and Similar Threaded Fasteners: ASTM A153, for galvanizing steel and iron hardware.
   3. Galvanizing Touch-Up Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
   4. At railings to be hot-dipped galvanized after fabrication: Fill vent and drain holes that will be exposed in finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

C. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface-preparation specifications and environmental exposure conditions of installed products:
   1. Exterior (SSPC Zone 1B): SSPC SP 6/NACE No. 3, "Commercial Blast Cleaning."
   2. Interior (SSPC Zone 1A): SSPC SP 3, "Power Tool Cleaning."
   3. Do not apply primer to galvanized surfaces.

D. Shop-Applied Primer and Field-Applied Paint (PT) or Epoxy Paint (PTE): Coordinate with Section 099000 - Painting.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions under which miscellaneous metal items are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Provide setting drawings, diagrams, templates, instructions and directions for installation of anchorages, such as concrete inserts, anchor bolts, and miscellaneous items having integral anchors, which are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.

B. Provide anchorage devices and fasteners where necessary for securing miscellaneous metal items to in-place construction; including threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws and other connectors as required.

C. Perform cutting, drilling and fitting required for installation of miscellaneous metal items. Set work accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items which are to be built into concrete, masonry or similar construction.

D. Fit exposed connections accurately together to form tight hairline joints. Weld connections which are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Grind joints smooth and touch up shop paint coat. Do not weld, cut or abrade surfaces of exterior units which have been hot-dip galvanized after fabrication, and are intended for bolted or screwed field connections.

E. Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance and quality of welds made, and methods used in correcting welding work.

F. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting. Apply by brush or spray to provide minimum dry film thickness of 2 mils.

G. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
   1. Cast Aluminum: Heavy coat of bituminous paint.
   2. Extruded Aluminum: Two coats of clear lacquer.

H. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

I. Field Welding: Comply with the following requirements:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

J. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

END OF SECTION

SECTION 078400
PENETRATION FIRESTOPPING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Firestop joint sealant and backing, including intumescent elastomeric compounds and sealants.
   2. Rigid boards, forms, wraps and accessories.
   3. Fiber packing and fiber fill.
   4. Wool fiber insulation and fire-safing insulation.
   5. Other firestopping as indicated.

1.2 ACTION SUBMITTALS

A. Product Data: Manufacturer's specifications and technical data for each material including the following.
   1. Composition and limitations.
   2. Manufacturer's installation instructions.
   3. Furnish sleeve size schedule indicating size of penetrating item, insulation thickness (where applicable), and minimum annular space requirements.

B. Proposed UL System Drawings - Special Installation Drawings: Prior to starting installation of firestopping, firestopping manufacturer and installer shall review specific conditions applicable for Project, and identify each condition for firestopping and prepare individual U.L. Designs or manufacturers engineering judgements identification numbers, and installation drawings for each condition.
   1. Submit 3 Special Installation Drawings for each condition, 1 set for Owner, 1 set for Architect’s File Copy, and 1 set for Building Official.
   2. Submit other information as may be requested by Building Official.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each penetration firestopping system, for tests performed by a qualified testing agency.

C. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Firm experienced in installation or application of systems similar in complexity to those required for this Project, plus the following.
   1. Acceptable to or licensed by manufacturer, State or local authority where applicable.
   2. Not less than 2 years' experience with systems.
   3. Successfully completed not less than 5 comparable scale projects using this system.

B. Field Samples: First two applications for each firestopping condition will be reviewed by Owner’s Representative and the Architect, and when accepted by the local Building Official shall become a standard of performance for remaining Work.
   1. Correct areas, modify method of application/installation, or adjust as directed by local code official to comply with specified requirements.

2. Maintain field samples accessible to serve as a standard of quality for this Section.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle to prevent damage, staining and disfigurement in original, new, and unopened packages and containers bearing manufacturer's name and label identifying contents. Do not freeze.

B. Where limited shelf life of product is noted by date on container or packing list, take note and do not use out of date material.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Store firestopping materials out of weather, in cool, dry place, out of direct sunlight, at temperatures below 90 degrees F, not less than 40 degrees F and as recommended by manufacturer.

B. Use of Foam Products: Store unmixed liquid components in original, unopened containers at temperature of 65 to 80 degrees F for 12 hours minimum before use. Use forced air ventilation in areas having less than 2 cubic feet of free air for each pound of liquid mixture being foamed.

1.7 PROJECT CONDITIONS

A. Environmental Requirements: Comply with fireproofing material manufacturer's recommendations for temperature and humidity conditions before, during, and after installation of fireproofing.

B. Ventilation Requirements: Comply with fireproofing material manufacturer's recommendations during and after installation of fireproofing by natural or mechanical means.

C. Sleeves: Unless otherwise called for, sleeves passing through walls, slabs, beams, bridging, columns, shall be minimum of 1/2 inch greater in inside diameter than external diameter of pipe passing through sleeves, or insulation diameter. Verify sleeve size required with manufacturer of firestopping used. Pipe insulation shall be continuous through sleeves. Space between sleeve and pipe or duct and annular opening space shall be provided with a firestop system. Notify Contractor immediately of deviation from above sleeving requirements.

D. Fire Dampers: Firestopping of annular spaces around fire dampers shall be placed before installation of damper's anchoring flanges.

1.8 SEQUENCING

A. Sequence and coordinate application of firestopping with other related work specified in other Sections to comply with the following requirements:

1. Provide temporary enclosures to prevent deterioration of firestopping for interior applications due to exposure to unfavorable environmental conditions.
2. Do not install enclosing or concealing construction until after firestopping has been applied, inspected, tested, and corrections have been made to any defective firestopping.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Single Source Responsibility for Materials: Obtain firestopping materials from one manufacturer for entire project.

1. This does not restrict Contractor from subcontracting installation of firestopping to multiple subcontracts, but does require all installers do use the same manufacturer throughout the Project and be licensed by that manufacturer for the installation of firestopping.

B. Acceptable manufacturers and products (FSTOP): Products listed in UL Fire Resistance Directory for UL System involved, that are manufactured by one of the following:
   1. 3M Fire Protection Products.
   2. Hilti Construction Chemicals, Inc.
   3. Grace Construction Products
   4. Nelson Firestop Products
   5. Rectorseal Company
   6. Specified Technologies Inc.
   7. Tremco
   8. US Gypsum Company

2.2 THROUGH-PENETRATION FIRESTOPPING OF FIRE RATED CONSTRUCTION

A. Fire-Test Response Characteristics: Provide through-penetration firestop systems that comply with the following requirements and those of this specification Section:
   1. Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL, ITS, or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.
   2. Through-penetration firestop systems are identical to those tested per ASTM E 814. Provide rated systems complying with the following requirements:
      a. Through-penetration firestop system products bear classification marking of qualified testing and inspecting agency.
      b. Through-penetration firestop systems correspond to those indicated by reference to through-penetration firestop system designations listed by the following:
         1) UL in “Fire Resistance Directory.”
         2) ITS in “Directory of Listed Products.”

B. Fire Rated Construction Design Requirements: Maintain barrier fire resistance ratings including resistance to cold smoke at all penetrations, connections with other surfaces or types of construction, at separations required to permit building movement and sound or vibration absorption, and at other construction gaps.

C. Through-Penetration Fire Stopping Schedule: Assembly designs are specified generally under UL system categories by penetrating item. Manufacturers' product applications must have specific UL system designations. The schedules on the following page indicate which Series of UL Classified Through Penetration Fire Stopping (TPFS) assemblies are acceptable for this Project based on barrier type, construction and penetrant type. The TPFS Series listed are generic in nature; ex: Series C-AJ-2000 includes all designs from 2001 through 2999 from all manufacturers; note that each manufacturer has its own number for tested assemblies. The Contractor will select appropriate TPFS assemblies for each condition encountered.

D. Refer to Schedule at the end of this section.

E. Design of firestopping described by this Section is responsibility of Contractor. Individual through-penetration systems, construction-gap firestopping, through-penetration smoke-stopping, and construction-gap smoke-stopping will be selected by Contractor to meet requirements of Contract Documents and governing codes. Actual selection of individual designs or systems is responsibility of Contractor, and ‘Single Source Responsibility for Materials’ is required.

F. Systems or devices listed in the UL Fire Resistance Directory under categories XHCR and XHEZ may be used, providing that they conform to the construction type, penetrant type, annular space requirements, and fire rating involved in each separate instance, and that the system be symmetrical for wall applications. Systems or devices must be asbestos-free.
   1. Additional requirements: Withstand the passage of cold smoke either as an inherent property of the product, or by the use of a separate product included as a part of the UL system or device, and designed to perform this function.

2.3 FIRESTOPPING, GENERAL

A. Compatibility: Provide through-penetration firestop systems that are compatible with one another, with the substrates forming openings, and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.

B. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by the qualified testing and inspecting agency for firestop systems indicated. Accessories include, but are not limited to, the following items:

1. Permanent forming/damming/backing materials, including the following:
   a. Slag-/rock-wool-fiber insulation.
   b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
   c. Fire-rated form board.
   d. Fillers for sealants.
2. Temporary forming materials.
3. Substrate primers.
4. Collars.
5. Steel sleeves.

2.4 FILL MATERIALS

A. General: Provide through-penetration firestop systems containing the types of fill materials indicated in the Through-Penetration Firestop System Schedule at the end of Part 3 by reference to the types of materials described in this Article. Fill materials are those referred to in directories of the referenced testing and inspecting agencies as fill, void, or cavity materials.

B. At Noise Critical Spaces: Provide permanently non-hardening systems at penetrations through fire-rated partitions and slabs, and at head of fire-rated partitions.

1. Gun or Trowel-Applied Intumescent Sealant: 3M “CPW-25WB+” or approved equal.
2. Moldable Intumescent Putty: 3M “Moldable Fire Stop” or approved equal.
3. Non-Intumescent Silicone Sealant: 3M “Silicone Fire Stop”, USG “Smokeseal” or approved equal) may be used in lieu of the sealant on foam rod in noise-sensitive fire-rated walls.

C. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic sleeve lined with an intumescent strip, a radial extended flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.

D. Latex Sealants: Single-component latex formulations that after cure do not re-emulsify during exposure to moisture.

E. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

F. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized steel sheet.

G. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.

H. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

I. Mortars: Prepackaged, dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

J. Pillows/Bags: Reusable, heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents and fire-retardant additives.

K. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

L. Silicone Sealants: Moisture-curing, single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:
   1. Grade for Horizontal Surfaces: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces.
   2. Grade for Vertical Surfaces: Nonsag formulation for openings in vertical and other surfaces.

M. Wiring devices: Ez-Path Fire Rated Pathway by Specified Technologies, Inc.
   1. Fire-rated wiring devices containing intumescent material that allows cable to pass through device and adjusts automatically to cable additions or removals.
   2. F Rating: Equal to rating of barrier in which device is installed.
   3. Capable of allowing a 0 to 100-percent visual fill of cables.
   4. Sufficient size to accommodate quantity and size of electrical wires and data cables required.
   5. Provide with steel wall plates allowing for single or multiple devices to be ganged together.

2.5 MIXING

A. For those products requiring mixing before application, comply with through-penetration firestop system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Clean out openings immediately before installing through-penetration firestop systems to comply with written recommendations of firestop system manufacturer and the following requirements:
   1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of through-penetration firestop systems.
   2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration firestop systems. Remove loose particles remaining from cleaning operation.
   3. Remove laitance and form-release agents from concrete.
   4. Do not allow caulks containing solvents to come in direct contact with plastic pipe.

B. Priming: Prime substrates where recommended in writing by through-penetration firestop system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

A. General: Install through-penetration firestop systems to comply with "Performance Requirements" Article and firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing fill materials, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.

C. Install fill materials for firestop systems by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 INSTALLATION

A. Use methods and materials indicated in firestopping systems shown in Referenced Standards.

B. Install penetration seal materials in accordance with instructions in UL Building Materials Directory and in accordance with manufacturer's printed instructions.

C. Install sealant, including forming, packing and other accessory materials to fill opening around services penetrating floors and walls to provide firestops with fire resistance ratings indicated for floor or wall assembly in which penetration occurs.

1. Use masking tape to protect finished substrates and products adjacent to sealant materials.
2. Apply sealant as specified under Section 079200 - Joint Protection, and as recommended by sealant manufacturer; apply bead to depth of 1-1/2 inches to fill void above support, or if mineral wool support is used to depth of 1/2 inch thick. Tool sealant immediately after application and before skin forms.
3. If using foam sealant, immediately after mixing, pour or inject liquid foam into penetration opening, not more than 1/3 full to compensate for expansion during cure or in strict accordance with sealant manufacturer's recommendations. Do not exceed measured snap time of foam sealant. Do not remove dams for 24 hours minimum to allow foam to fully cure.

D. At sleeved pipes or other sleeved penetration, firestop annular space between sleeve and its contained pipe or duct with resilient firestopping sealant system to permit movement of pipe or duct without damage to firestopping sealant.

E. Seal holes and voids made by penetrations to ensure effective fire and smoke barrier.

F. Patch penetrations caused by cutting or presence of unused or abandoned openings or boxes using materials compatible with barrier construction and with fire rating equal to or greater than barrier rating.

G. For plumbing sleeves, construct time rated walls after placement of penetrating materials if possible, and to fit rated construction materials tightly to or directly upon material of penetration.

H. Large Openings: Close unused portions of large openings (annular spaces) made for later installation of pipes and ducts with solid fill equal to barrier rating or with applicable firestopping sealant system.
   1. Where both horizontal dimensions exceed 4 inches in structural floor openings, firestop annular spaces with concrete, or other rated assembly. Provide dowels and reinforcement, within such fill, equal to that specified for slab.
   2. In rated concrete or masonry wall openings where both height and width exceed thickness of rated materials, firestop annular spaces with masonry or other solid fill.
   3. Use fiber fill, solid fill or fiber packing to make up remainder of barrier thickness where required width of firestopping sealant system is less than barrier.

I. Install firestopping materials capable of supporting same loading as floor at floor openings more than four inches in width without penetrating item and subject to traffic or loading.

J. Install firestopping at least equal to barrier fire rating in and around penetrations of floor structures, exterior walls and interior walls noted as time rated fire barriers or smoke barriers.

K. Unused or abandoned openings or boxes or penetrations caused by cutting shall be patched with materials compatible with barrier construction and with fire rating equal to or greater than barrier fire-rating.

L. Use firestopping sealant systems at narrow spaces and at spaces with dimensions less than barrier thickness.

M. Fill void spaces completely with firestopping material.

N. Protect materials from damage on surfaces subject to traffic. Provide firestopping in floors flush with top of slab, sleeve or housekeeping pad.

3.5 IDENTIFICATION

A. Identify through-penetration firestop systems with pressure-sensitive, self-adhesive, preprinted vinyl labels. Attach labels permanently to surfaces of penetrated construction on both sides of each firestop system installation where labels will be visible to anyone seeking to remove penetrating items or firestop systems. Include the following information on labels:

Warning – Fire-stop System
DO NOT DISTURB
Notify Building Management of Any Damage

Manufacturer's System No. _____
UL System No: _____
Contractor: _____
Date Installed: _____
Manufacturer: _____

3.6 FIELD QUALITY CONTROL

A. Inspecting Agency: Owner will engage a qualified independent inspecting agency to inspect through-penetration firestop systems and to prepare test reports.

1. Inspecting agency will state in each report whether inspected through-penetration firestop systems comply with or deviate from requirements.

B. Proceed with enclosing through-penetration firestop systems with other construction only after inspection reports are issued.

C. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with requirements.

D. Manufacturer's Field Services: Firestopping manufacturer's technical representative shall provide the following field services during application.
   1. Perform a pre-installation examination and acceptance of substrate and voids scheduled for firestopping. Issue report.
   2. Be present at initial start-up for each process. Confirm application techniques. Issue report.
   3. Issue a summary report at completion of installation indicating manufacturer's acceptance of installed system and compliance with UL Design requirements.

3.7 ADJUSTING AND CLEANING

A. Clean up spills of liquid components.

B. Neatly cut and trim materials.

C. Remove equipment, materials and debris, leaving area in undamaged, clean condition.

3.8 SCHEDULE

THROUGH-PENETRATION UL CLASSIFICATION SYSTEM

	Fire Stopping Systems	**UL Classification System**		
		Construction Penetrated	Type Of Construction	System Identification
1	No Penetrating Items:	F, W, C	A, B, J, K, L	0001-0999
2	Metallic Pipes, Conduit or Tubing:	F, W, C	A, B, J, K, L	1001-1999
3	Nonmetallic Pipe, Conduit or Tubing:	F, W, C	A, B, J, K, L	2001-2999
4	Electric Cables:	F, W, C	A, B, J, K, L	3001-3999
5	Cable, Trays with Electric Cables:	F, W, C	A, B, J, K, L	4001-4999
6	Insulated Pipes:	F, W, C	A, B, J, K, L	5001-5999
7	Electrical Bussduct Penetrations:	F, W, C	A, B, J, K, L	6001-6999
8	Mechanical Ductwork Penetrations:	F, W, C	A, B, J, K, L	7001-7999
9	Multiple Penetrations Through Common Openings:	F, W, C	A, B, J, K, L	8000-8999

Construction Penetration

F	Floor penetration
W	Wall penetration
C	Either Wall or Floor Penetration

Type of Construction

A-	Concrete floors equal to or less than 5-inches thick
B-	Concrete floors greater than 5-inches thick
J-	Concrete or masonry walls equal to or less than 8-inches thick
K-	Concrete of masonry walls greater than 8-inches thick
L-	Framed walls

JOINT UL CLASSIFICATION SYSTEM

Fire-Resistant Joint Systems		**UL Classification System**		
		Joint System	Movement Capability	Joint Width range
1	Floor-to-Floor	FF	S/D	0000-4999
2	Wall-to-Wall	WW	S/D	0000-4999
3	Floor-to-Wall:	FW	S/D	0000-4999
4	Head-to-Wall:	HW	S/D	0000-4999
5	Wall-to-Wall as Corner Guards	CG	S/D	0000-4999
6	Bottom of Wall	BW	S/D	0000-4999

Movement Capability

S- No movement (Static)

D- Allows movement (Dynamic)

Joint Width

0000-0999 Less than or equal to 2 inches

1000-1999 Greater than 2 inches and less than or equal to 6 inches

2000-2999 Greater than 6 inches and less than or equal to 12 inches

3000-3999 Greater than 12 inches and less than or equal to 24 inches

4000-4999 Greater than 24 inches

END OF SECTION

SECTION 079200
JOINT SEALANTS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Exterior and interior sealants (SLNT).

B. Related Sections:
   1. Section 092900 - Gypsum Board: Acoustical sealant at gypsum board systems.

1.2 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product.
   1. Submit Manufacturer's certifications that products comply with specified requirements and with local regulations for VOC content.

B. Color Samples:
   1. Samples for Initial Selection: Manufacturer's color charts consisting of actual strips of cured sealants showing the full range of colors available for each product exposed to view.
   2. Samples for Verification: For each kind and color of joint sealant selected, provide Samples with joint sealants in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

C. Product Schedule: Cross-reference products using "SLNT" designation in Part 2 of this Section, with Sealant Schedule in Part 3 of this Section, to locations and applications. Indicate proposed product, product type and color.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Sample Warranties: For special warranties.

C. Quality Control Submittals:
   1. Product Test Reports: For each kind of joint sealant.
   2. Preconstruction Laboratory Test Reports: From sealant manufacturer, indicating the following:
   3. Statement of qualification for manufacturers and installers.
   4. Statement of compliance for compatibility of sealant with adjacent materials and coatings.
   5. Field-Adhesion-Test Reports: For each sealant application tested.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Engage experienced Installer who has completed joint sealant applications similar in material, design, and extent to that indicated for Project that have resulted in construction with record of successful in-service performance.

B. Provide materials for exterior envelope from a single manufacturer.

C. Compatibility: Verify compatibility of silicone sealant with materials in contact with sealant. Provide list of stone materials and verify that silicone sealant will not stain or damage stone work.

D. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

E. Integrated Mockups: Provide joint sealants for integrated mockups in accordance with Section 014300 - Mockups.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to project site in original unopened containers or bundles with labels informing about manufacturer, product name and designation, color, expiration period for use, pot life, curing time and mixing instructions for multi component materials.

B. Store and handle materials to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.6 PROJECT CONDITIONS

A. Weather Conditions: Do not proceed with installation of sealant under adverse weather conditions, or when temperatures are below or above manufacturer's recommended limitations for installation.
   1. Proceed with work only when forecasted weather conditions are favorable for proper cure and development of high early bond strength.
   2. Wherever joint width is affected by ambient temperature variation, apply elastomeric sealant only when temperatures are in lower third of manufacturer's recommended installation temperature range, so that sealant will not be subjected to excessive elongation and bond stress at subsequent low temperatures.

B. Joint Width Conditions: Do not proceed with installation of joint sealers when joint widths are less than allowed by joint sealer manufacturer for application indicated.

C. Joint Substrate Conditions: Do not proceed with installation of joint sealers until contaminants capable of interfering with their adhesion are removed from joint substrates.

D. Compatibility and Adhesion Testing: Ascertain sealant compatibility and adhesion with adjacent materials using laboratory testing procedures.

PART 2 PRODUCTS

2.1 SEALANT, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. Sealant Colors: In accordance with approved sealant color schedule.
   1. Colors as selected by Architect from manufacturer’s standard colors. Acceptance of sealant will depend on range of standard colors available for selection.
   2. Custom Color:

C. Interior Sealants: Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

D. VOC Content of Interior Sealants: Provide sealants and sealant primers for use inside the weatherproofing system that comply with the following limits for VOC content when calculated according to 40 CFR 59, Part 59, Subpart D (EPA Method 24):
   1. Architectural Sealants: 250 g/L.
   2. Sealant Primers for Nonporous Substrates: 250 g/L.
   3. Sealant Primers for Porous Substrates: 775 g/L.

2.2 POLYURETHANE SEALANT

A. (SLNT-1) 1-Part Polyurethane Sealants: Polyurethane based one part elastomeric sealant, complying with FS- TT-S-00230C, Type II Class A, with elongation and compression of not less than 25 percent. ASTM C920, Type S, Class 25, Grade NS.
   1. Manufacturers and Products:
      a. Sika Chemical Corporation: Sikaflex-1a.
      b. BASF Building Systems: Sonolastic NP-1.
      c. Tremco Incorporated: Dymonic.
      d. Pecora Corporation: Dynatrol I.
      e. Tremco Incorporated: Vulkem 116.

B. (SLNT-2) 2-Part Polyurethane Sealant for Horizontal Applications: Self-leveling polyurethane based 2 part elastomeric sealant, complying with FS-TT-S-00227E, Type I, Class A, with shore A hardness of not less than 30 and elongation and compression of not less than 25 percent. ASTM C920, Type M, Class 25, Grade P.
   1. Manufacturers and Products:
      a. Tremco Incorporated: THC900.
      b. BASF Building Systems: Sonolastic SL-2.
      c. Pecora Corporation: Urexpan NR-200.
   2. Location/Use:
      a. Joints in horizontal surfaces subject to traffic.
      b. Isolation joints in cast-in-place concrete slabs.
      c. Other joints as indicated.

C. (SLNT-5) Single-Component, Nonsag, Urethane Adhesive and Sealant: ASTM C 920, Type S, Grade NS, Class 35, Use NT, M, A, T, O and I, FS TT-S-00230C, Type II, Class A.
   1. Manufacturers and Products:
      a. MasterSeal NP-1, by Master Builders solution, BASF Corporation
   2. Application: For use **under sheet metal flashing** to bond and seal to substrate.

2.3 SILICONE SEALANT

A. (SLNT-3) Low-Modulus Silicone Rubber Sealant: Silicone rubber based, one part neutral cure elastomeric sealant with plus 50 percent to minus 50 percent movement complying with FS-TT-S-001543, Class A, and recommended by manufacturer for joints.
   1. Manufacturers and Products:
      a. General Electric: Silpruf SCS 2000.
      b. Dow Corning Corporation: 795 Building Sealant.
      c. BASF Building Systems: Sonolastic Omniseal or OmniPlus.
      d. Pecora Corporation: 864 Silicone.
      e. Tremco Construction Division: Spectrem 3.

B. (SLNT-4) Medium-Modulus Silicone Rubber Sealant: Silicone rubber based, specifically designed for weatherproofing stone or other porous materials, two part moisture cure elastomeric sealant with plus 50 percent to minus 50 percent movement and recommended by manufacturer for stone joints.
   1. Manufacturers and Products:
      a. General Electric: Silpruf SCS 2000.
      b. Dow Corning Corporation: 756 Building Sealant.
      c. Tremco Construction Division: Spectrem 2.

C. (SLNT-5) Ultra-Low-Modulus Silicone Rubber Sealant: Silicone rubber based, one part neutral cure elastomeric sealant with plus 100 percent to minus 50 percent movement complying with FS-TT-S-001543, Class A.
   1. Manufacturers and Products:

a. Dow Corning Corporation: 790 Building Sealant.
b. Tremco Construction Division: Spectrem 1.

D. (SLNT-6) Silyl-Terminated Polyurethane Joint Sealant (STPU): ASTM C920, Type S, Grade NS, Class 12.5, for Us NT.
1. Product and Manufacturer:
a. Dymonic FC, by Tremco Incorporated:
b. Dyanflex SC, by Pecora Corporation
2. Application: **Adhering joint dowel pins at stonework**.

E. (SLNT-8) Silicone Sealant, Mildew-Resistant: ASTM C 920; Type S; Grade NS; Class 25; Uses NT, G, A, and, as applicable to nonporous joint substrates indicated, O; formulated with fungicide, intended for sealing interior nonporous substrates that are subject to in-service exposures of high humidity and extreme temperatures.
1. Products and Manufacturers:
a. Dow Corning Corporation; Dow Corning 786.
b. GE Silicones; a division of GE Specialty Materials; Sanitary 1700.
c. Laticrete International, Inc.; Latasil Tile & Stone Sealant.
d. Pecora Corporation; Pecora 898 Sanitary Silicone Sealant.
e. Tremco Incorporated; Tremsil 600 White.
2. Location/Use:
a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
b. Tile control and expansion joints where indicated.
c. Joints subject to water and high moisture areas.
d. Other joints as indicated.

F. (SLNT-9) Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for Use NT; field-tintable; non-staining.
1. Field-Tinted: Provide at locations as directed by Architect.
a. Basis of Design: Pecora Corporation; 890FTS.
b. Color: As selected by Architect to match <INSERT>.
2. Field-Tinted and Textured: Provide at locations as directed by Architect.
a. Basis of Design: Pecora Corporation; 890FTS-TXTR.
b. Color: As selected by Architect to match <INSERT>.

2.4 BUTYL SEALANT

A. (SLNT-__) Concealed Sealant; Butyl Sealant: Non-skinning, non-drying, flexible synthetic butyl sealant.
1. Manufacturers and Products:
a. Tremco Construction Division; TremPro JS-773.
b. Pecora Corporation; BA-98.
2. Location/Use: concealment locations, such as flashing backpane joints, coping joints, roof edge joints, setting aluminum storefront windows, window sills, etc. and where called for in other assemblies.

2.5 ACRYLIC SEALANT

A. (SLNT-7) Acrylic Sealants: General purpose, paintable acrylic-emulsion sealant. Caulk with approximately 12-1/2 percent elongation complying with ASTM C834.
1. Products and Manufacturers:
a. Tremco Incorporated: Acrylic Latex 834.
b. BASF Building Systems: Sonolac.
c. Pecora Corporation: AC-20.
2. Location/Use:

a. Joints in vertical surfaces and in horizontal surfaces not subject to traffic.
b. Control and expansion joints on exposed interior surfaces of exterior walls.
c. Vertical joints on exposed surfaces of interior unit masonry, concrete, walls, and partitions.
d. Perimeter joints between interior wall surfaces and frames of interior doors, windows and elevator entrances.
e. Joints between plant-precast structural concrete units.
f. Other joints as indicated.

2.6 JOINT SEALANT BACKING

A. Joint Sealant Backer Rod Manufacturers:
   1. Denver Foam, Backer Rod Manufacturing, Inc.
   2. Sonneborn Sonolastic, BASF Building Systems.
   3. Construction Foam Products, Nomaco Inc..

B. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

C. Sealant Backing Material: Nonstaining, sealants, primers, and other joint fillers; compatible with joint substrates; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

D. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

E. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.7 PREPARATORY MATERIALS

A. Joint Primer: Non-staining type recommended by sealant manufacturer to suit application.

B. Joint Cleaner: Non-corrosive type recommended by sealant manufacturer; compatible with joint forming materials.

C. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

D. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine joint surfaces, backing, and anchorage of units forming sealant rabbet, and conditions under which sealant work is to be performed. Do not proceed with sealant work until unsatisfactory conditions have been corrected.

3.2 JOINT SURFACE PREPARATION

A. Preparation: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.
   1. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
   2. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

B. Clean joint surfaces immediately before installation of sealant. Remove dirt, insecure coatings, moisture and other substances which would interfere with bond of sealant.

C. Etch concrete and masonry joint surfaces to remove excess alkalinity, unless sealant manufacturer's printed instructions indicate that alkalinity does not interfere with sealant bond and performance. Etch with 5 percent solution of muriatic acid; neutralize with dilute ammonia solution, rinse thoroughly with water and allow to dry before sealant application.

D. Roughen joint surfaces on vitreous coated and similar non-porous materials, wherever sealant manufacturer's data indicates lower bond strength than for porous surfaces. Rub with fine abrasive cloth or steel wool to produce dull sheen.

E. Ensure that joint forming materials are compatible with sealant.

F. Examine joint dimensions and size materials to achieve required width/depth ratios. Use joint filler to achieve required joint depths, to allow sealants to perform properly.

3.3 SEALANT APPLICATION

A. Installation:
   1. Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
   2. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
   3. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
   4. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
   5. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

B. Apply sealant in accordance with manufacturer's printed instructions. Perform work in accordance with ASTM C804.

C. Prime or seal joint surfaces. Do not allow primer/sealer to spill or migrate onto adjoining surfaces.

D. Install sealant backer rod for liquid elastomeric sealant, except where recommended to be omitted by sealant manufacturer for application shown.

E. Install bond breaker tape wherever required by manufacturer's recommendations to ensure that elastomeric sealant will perform properly.

F. Employ only proven installation techniques, which will ensure that sealant will be deposited in uniform, continuous ribbons without gaps or air pockets, with complete "wetting" of joint bond surfaces equally on opposite sides.
   1. Except as otherwise indicated, fill sealant rabbet to slightly concave surface, slightly below adjoining surfaces. Where horizontal joints are between horizontal surface and vertical surface, fill joint to form slight cove, so that joint will not trap moisture and dirt.

G. Install sealant to depth as shown or, if not shown, as recommended by sealant manufacturer but within following general limitations, measured at center (thin) section of bead:
   1. For sidewalks, pavements and similar joints sealed with elastomeric sealant and subject to traffic and other abrasion and indention exposures, fill joints to depth equal to 75 percent of joint width, but not more than 5/8 inch deep nor less than 3/8 inch deep.
   2. For normal moving joints sealed with elastomeric sealant, but not subject to traffic, fill joint to depth equal to 50 percent of joint width, but not more than 1/2 inch deep nor less than 1/4 inch deep.

H. Interior joints not subject to movement, these are:
   1. Gypsum board to masonry joints.
   2. Gypsum board to hollow metal joints.
   3. Gypsum board to concrete joints.

I. Do not allow sealant or compounds to overflow or flow onto adjoining surfaces, or to migrate into voids of adjoining surfaces including rough texture surfaces. Use masking tape or other precautionary devices to prevent staining of adjoining surfaces, by either primer/sealer or sealant.

J. Remove excess and spillage of sealant promptly as work progresses. Clean adjoining surfaces by whatever means may be necessary to eliminate evidence of spillage, without damage to adjoining surfaces or finishes.

K. Rope Wicks: Where wicks for weeping masonry cavity occur in sealant, cut wick flush with sealant face and do not seal wick ends.

3.4 PROTECTION AND CLEANING

A. Protect joint sealers during and after curing period from contact with contaminating operations or other causes so that they are without deterioration or damage at time of Substantial Completion.
   1. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealers immediately and reseal joints with new materials to produce joint sealer installations with repaired areas indistinguishable from original work.

B. Clean off excess sealant or sealant smears adjacent to joints as work progresses by methods and with cleaning materials approved by manufacturers of joint sealers and of products in which joints occur.

3.5 JOINT-SEALANT SCHEDULE

A. General: Provide sealant where indicated (SLNT) or as required to achieve a weather-tight assembly.
   1. Joint-Sealant Colors: As selected by Architect from manufacturer's full range of colors.
   2. The following schedule is not intended to be all-inclusive and some may not be applicable to this Project.

B. Exterior Joints:
   1. Horizontal Surfaces Subject to Traffic:
      a. Joint Locations:
         1) Isolation and contraction joints in cast-in-place concrete slabs.

2) Joints between plant-precast architectural concrete paving units.
3) Joints in stone paving units, including steps (where applicable).
4) Tile control and expansion joints.
5) Joints between different materials listed above.
6) Other joints as indicated.

b. (SLNT-2): 2-Part polyurethane sealant, self-leveling, traffic grade, Class 25 .

2. Horizontal Surfaces Subject to Traffic and Water Immersion:
   a. (SLNT-_): Polyurethane sealant, submersible, multi-component, self-leveling traffic grade.
3. Vertical Surfaces and Horizontal Surfaces Not Subject to Traffic:
   a. Joint Locations:
      1) Construction joints in cast-in-place concrete.
      2) Control and expansion joints in unit masonry.
      3) Joints between metal panels.
      4) Joints between different materials listed above.
   b. (SLNT-3): Silicone single component, nonsag, neutral curing, Class 25
   c. (SLNT-4): Silicone multicomponent, nonsag, neutral curing.
4. Perimeter joints between materials listed above and frames of doors, windows, and louvers:
   a. (SLNT-4): Silicone multicomponent, nonsag, neutral curing.
5. Vertical Surfaces and Horizontal Surfaces Not Subject to Traffic:
   a. Joint Locations:
      1) Unit Masonry Glazed Aluminum Framing System.
      2) Metal Panel to Glazed Aluminum Framing System.
   b. (SLNT-5) Silicone Ultra Low-Modulus Silicone Rubber Sealant.
6. Vertical Surfaces and Horizontal Surfaces Not Subject to Traffic:
   a. Joint Locations:
      1) Stone to Stone
      2) Stone to Masonry
      3) Cast Stone to Cast Stone
      4) Stone to Cast Stone
   b. (SLNT-9): Silicone Single-Component, Nonsag, Neutral-Curing.

C. Interior Joints:
1. Horizontal Surfaces Subject to Traffic:
   a. Joint Locations:
      1) Isolation joints in cast-in-place concrete slabs.
      2) Other joints as indicated.
   b. (SLNT-2): 2-Part polyurethane sealant, self-leveling, traffic grade, Class 25 .
2. Vertical Surfaces and Horizontal Surfaces Not Subject to Traffic: Acrylic-based.
   a. Control and expansion joints on exposed interior surfaces of exterior walls.
   b. Perimeter joints of exterior openings where indicated.
   c. Tile control and expansion joints.
   d. Vertical joints on exposed surfaces of interior unit masonry, concrete, walls, and partitions.
      1) (CMU) to (CMU): Low modulus silicone sealant.
   e. Perimeter joints between interior wall surfaces and frames of interior doors, windows and elevator entrances.
   f. Joints between plant-precast structural concrete units.
   g. Other joints as indicated.
3. Mildew-Resistant Sealant: Mildew resistant, single component, nonsag, neutral curing, Silicone.
   a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
   b. Tile control and expansion joints where indicated.
   c. Other joints as indicated.
4. Acoustic Joint Sealant: Acoustical. Refer to Section 092900 for acoustic sealant in gypsum board assemblies.

END OF SECTION

SECTION 092900
GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes (GYP BD): Interior gypsum board.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 DELIVERY, STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.4 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.

B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL

A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

A. Manufacturers:

1. United States Gypsum.
2. National Gypsum Company.
3. Georgia-Pacific.
4. CertainTeed Co n.

5. Temple-Inland.

B. Gypsum Board, Type X (GYP BD-1): ASTM C 1396/C 1396M.
   1. Thickness: 5/8 inch (15.9 mm).
   2. Long Edges: Tapered.
   3. Acceptable products and manufacturers: Equivalent to Sheetrock Brand SW, Firecode Gypsum Panels by United States Gypsum (USG).

2.4 ACCESSORIES

A. Interior Trim: ASTM C 1047.
   1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
   2. Shapes:
      a. Cornerbead.
      b. LC-Bead: J-shaped; exposed long flange receives joint compound.
      c. L-Bead: L-shaped; exposed long flange receives joint compound.
      d. U-Bead: J-shaped; exposed short flange does not receive joint compound.
      e. Expansion (control) joint.
   3. Interior Trim (GYPA-1): Interior trim of dimensions and profiles indicated on Drawings.

2.5 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:
   1. Interior Gypsum Board: Paper.

C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.
   1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
   2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping or drying-type, all-purpose compound.
      a. Use setting-type compound for installing paper-faced metal trim accessories.
   3. Fill Coat: For second coat, use setting-type, sandable topping or drying-type, all-purpose compound.
   4. Finish Coat: For third coat, use setting-type, sandable topping or drying-type, all-purpose compound.

2.6 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

C. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.
   1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.

D. Closed-Cell Tape Sponge Neoprene: Press-on Products, No. P-8200 or P-8100, or approved equal.

E. Foam Backer Rod: Closed cell polyethylene, ASTM C962: by ITP, Nomeco, or approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Sprayed Fire-Resistive Materials: Coordinate with gypsum board shaft wall assemblies so both elements of Work remain complete and undamaged. Patch or replace sprayed fire-resistive materials removed or damaged during installation of shaft wall assemblies to comply with requirements specified in Section 078100 "Applied Fire Protection."

3.3 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
2. Fit gypsum panels around ducts, pipes, and conduits.
3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

3.4 APPLYING INTERIOR GYPSUM BOARD

A. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
2. On partitions/walls, apply gypsum panels vertically (parallel to framing) or horizontally (perpendicular to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
   a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
   b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.
3. On Z-shaped furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

B. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 400 mm (16 inches) minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
3. On Z-shaped furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
4. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

C. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written instructions and temporarily brace or fasten gypsum panels until fastening adhesive has set.

3.5 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints at locations indicated on Drawings, according to ASTM C 840 and in specific locations approved by Project Director/COR for visual effect.

3.6 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints, rounded or beveled edges, and damaged surface areas.

C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.

2. Level 2: Panels that are substrate for tile, except remove toll marks and ridges.
3. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
   a. Primer and its application to surfaces are specified in Section 099000 "Painting."

3.7 PROTECTION

A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
   1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
   2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

SECTION 099000
PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes surface preparation and the application of paint systems on interior substrates including, but not limited to, the following:

1. Steel.
2. Gypsum board.

1.2 DEFINITIONS

A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.

B. MPI Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

C. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

D. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.

E. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

F. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

G. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

1. Include Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
2. Indicate VOC content.

B. Samples: For each type of paint system and in each color and gloss of topcoat.

1. Submit Samples on rigid backing, 8 inches square.
2. Apply coats on Samples in steps to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

C. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.5 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Products and Manufacturers:

1. Listed products establish a standard of quality and are manufactured by Sherwin-Williams.
2. Equivalent products by the following manufacturers may be acceptable provided they comply with requirements of the Contract Documents.
    a. Benjamin Moore.
    b. Duron Inc.

B. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to products listed in the Interior Painting Schedule for the paint category indicated.

2.2 PAINT, GENERAL

A. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

B. VOC Content: For field applications that are inside the weatherproofing system, paints and coatings shall comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:

1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 50 g/L.
3. Dry-Fog Coatings: 150 g/L.
4. Primers, Sealers, and Undercoaters: 100 g/L.
5. Rust-Preventive Coatings: 100 g/L.
6. Zinc-Rich Industrial Maintenance Primers: 100 g/L.
7. Pretreatment Wash Primers: 420 g/L.
8. Shellacs, Clear: 730 g/L.
9. Shellacs, Pigmented: 550 g/L.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Gypsum Board: 12 percent.

C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

D. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.

E. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:

1. SSPC-SP 3.

E. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

F. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

3.3 PREPARATION OF EXISTING SURFACES

A. General:

1. Remove blistered, peeling and scaling paint or chalk deposits to sound substrates.
2. Completely remove sealants or caulking.
3. Dull glossy surfaces.

B. Ferrous Metal:

1. Clean surfaces of oil, grease and other soluble contaminants in accordance with SSPC-SP1 “Solvent Cleaning”.
2. Clean surfaces of rust and other insoluble contaminants in accordance with SSPC-SP2 “Hand Tool Cleaning” or SSPC-SP3 “Power Tool Cleaning”.
3. Sand clean and spot prime.

C. Galvanized Steel:

1. Clean surfaces of oil, grease and other soluble contaminants in accordance with SSPC-SP1 “Solvent Cleaning”.
2. Wire-brush or power wash weathered, unpainted surfaces to remove “white rust” deposits.
3. Sand clean and spot prime.

3.4 APPLICATION

A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

A. Interior Ferrous Metal:

1. Surfaces include, but are not limited to, the following:
    a. Hollow metal frames.
    b. Other locations as indicated.
2. Waterborne Zero-VOC, Low-Odor System: Zero-VOC, Low-Odor Acrylic over Waterborne Metal Primer; not less than 35 percent solids, ammonia free coating.
    a. VOC Requirement: Not more than 50 grams VOC’s per liter,
    b. Primer: 1 coat S-W DTM Acrylic Primer, B66W1.
    c. Finish: 2 coats S-W ProMar 200 Zero-VOC Interior Latex Semi-Gloss, B31-2600 Series.

B. Gypsum Wallboard:

1. Sheens, General: Unless noted otherwise on Room Finish Schedule.
    a. Walls:
        1) Typical: Eggshell

2) Staff Toilet Room: Semi-gloss.

b. Ceilings and Soffits: Flat

c. Walls where indicated on Room Finish Schedule: Semi-gloss.

2. Waterborne Zero-VOC, Low-Odor System: Zero-VOC, Low-Odor Acrylic Finish over Zero-VOC, Low-Odor Acrylic Primer - not more than 50 grams VOCs per liter, not less than 35 percent solids, ammonia free coating.

a. Primer: 1 coat S-W ProMar 200 Zero-VOC Interior Latex Primer, B28W2600 Series.

b. Finish:

1) 2 coats S-W ProMar 200 Zero-VOC Interior Latex Flat, B30-2600 Series.

2) 2 coats S-W ProMar 200 Zero-VOC Interior Latex Egg-Shell, B20-2600 Series.

3) 2 coats S-W ProMar 200 Zero-VOC Interior Latex Semi-Gloss, B31-2600 Series.

3.7 SMOKE AND FIRE PARTITIONS

A. Stenciling: Fire walls, fire barriers, fire partitions, smoke barriers and smoke partitions to be stenciled with the appropriate Hour-rating/Minute rating, i.e., "SMOKE and/or FIRE (1 HR /2 HR) – Protect All Openings," etc. as indicated on the Life Safety Plan, above ceilings on both sides of walls in letters not less than 3 inches high and 3/8 inch wide stroke. Refer to IBC Article 703 for additional information.

1. Stenciling shall be located above every door and no more than fifteen feet on center.
2. Stencil every change in direction of rated walls.
3. Indicate the end of a rated wall with a 2-inch vertical red line with an arrow pointing to the direction of the rated wall.

END OF SECTION

SECTION 150100
BASIC MECHANICAL REQUIREMENTS

PART I - GENERAL

1.01 RELATED SECTIONS

A. 150500 – Basic Mechanical Materials and Methods

B. 150600 – Pipes and Pipe Fittings

C. 151000 – Valves and Piping Specialties

D. 152500 – Mechanical Insulation

E. 157620 – Fan Coil units

F. 159600 – Energy Management Systems

G. 159900 – Testing Adjusting and Balancing

1.02 REQUIREMENTS OF REGULATORY AGENCIES

A. Provide work and materials in full accordance with the latest rules and regulations of the following:

1. California Code of Regulations – Title 17
2. California Code of Regulations – Title 24 – Parts 2, 3, 4, 5, and 9
3. California Code of Regulations – Title 22 – Chapter 7
4. National Electric Code – 2012 Edition with 2016 Edition of State of California Amendments
5. National Fire Protection Association
6. Cal OSHA, Title 8 CCR or CA Labor Code
7. Occupational Safety and Health Administration
8. State Fire Marshal, Title 19 CCR
9. International Building Code – 2012 Edition with 2016 Edition of State of California Amendments
10. International Fire Code – 2012 Edition with 2016 Edition of State of California Amendments
11. Uniform Mechanical Code – 2012 Edition with 2016 Edition of State of California Amendments
12. Uniform Plumbing Code – 2012 Edition with 2016 Edition of State of California Amendments
13. AWWA 9th Edition
14. SMACNA Guidelines and Specifications
15. Other applicable state laws

B. Nothing in Drawings or specifications shall be construed to permit work not conforming to these codes.

C. Conform to State of California Energy Conservation Standards for all systems, equipment, and construction.

D. When contract documents differ from governing codes, furnish and install larger size or higher standards called for without extra charge.

E. No material installed as part of this Work shall contain asbestos in any form.

1.03 QUALITY ASSURANCE

A. Plumbers' Qualifications:

1. Plumbing: Certified in accordance with City of Sacramento, Chapter 9 of the Sacramento City Code, Article XXIV, Certification of Journey level Plumbers.

B. Show current certifications upon request.

C. Certification shall be copied and kept on file by Contractor for duration of the job and provided to University's Representative upon project completion.

1.04 FEES, PERMITS, AND UTILITY SERVICES

A. Obtain and pay for all permits and service required in installation of this work; arrange for required inspections and secure approvals from authorities having jurisdiction. The University will pay for all OSHPD permits, if applicable.

B. Arrange for utility connections. The University shall pay charges incurred, including excess service charges, if any.

1.05 SITE EXAMINATION

A. Examine site, verify dimensions and locations against Drawings, and inform self of conditions under which work is to be done before submitting proposal. No allowance will be made for extra expense on account of error.

B. Information shown relative to existing services is based upon available records and data but is approximate only. Make minor deviations found necessary to conform to actual locations and conditions without extra cost. Verify location and elevation of utilities prior to commencement of excavation for new piping or its installation.

C. Exercise extreme care in excavating near existing utilities to avoid any damage thereto. Contractor is responsible for any damage caused by Contractor's operations.

D. All material and equipment removed from site as part of this project is the property of the University unless specifically designated otherwise and shall be delivered to a location at the University as directed by the University's Representative.

1.06 PLACEMENT OF EQUIPMENT AND WORK

A. The placement of equipment and mechanical work in the locations and spaces shown on the Drawings is the Contractor's responsibility.

B. Move equipment and/or work into spaces through openings provided or located in the spaces during construction, as required.

C. Do disassembling and reassembling of equipment or other work necessary to accomplish this requirement without extra cost to the University.

1.07 MATERIAL LIST AND SUBSTITUTIONS

A. Comply with the requirements as stated in Specification Section 01330 and 01610. Partial or incomplete lists of material will not be considered.

B. Installation of reviewed substitution is Contractor's responsibility. Any changes required for installation of reviewed substituted equipment must be made without additional cost. Review by the University's Representative of the substituted equipment and/or dimensional Drawings does not waive these requirements.

1.08 EQUIPMENT DATA AND OPERATION AND MAINTENANCE INSTRUCTIONS

A. Submit equipment data and operation and maintenance instructions in accordance with Specification Section 01780, Closeout Submittal. Submit on all items for each and every system and piece of equipment furnished under these specifications. Equipment data to include full description of equipment, model number, serial number, nomenclature per Construction Documents, performance characteristics, performance curves and wiring diagrams. Best to include all information provided in the equipment submittal plus operation and maintenance instruction. Include copies of manufacturer’s Guarantee/Warranty.

B. Contractor shall start compiling the above data, including operating and maintenance instruction data, catalog cuts and diagrams from the equipment manufacturer so as not to delay Projection completion.

C. Incorporate complete operating instructions including starting, stopping, and description of emergency manual operation methods for the following:

1. Mechanical Systems.
2. Plumbing Systems.
3. Piping Systems.
4. Provide performance curves, charts and diagrams were applicable.
5. Provide operating manual for all equipment listed in individual sections of the specification.

D. Provide maintenance instructions for each item of individual equipment covering pertinent maintenance data, such as lubricants to be used, frequency of lubrication, inspections required, adjustments, belt and pulley sizes, etc.

E. Provide parts bulletins containing manufacturer's bulletins with part numbers, instructions, etc. for each item of equipment. Strip bulletins so that useless bulk is avoided.

F. Post service telephone numbers and/or addresses in an appropriate place as designated by the University Representative.

PART II - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. As mentioned herein or on Drawings, Contractor to provide each item listed of quality noted or equal. All material shall be new, full weight, standard in all respects, and in first-class condition. Provide materials of the same brand or manufacture throughout for each class of material or equipment wherever possible. Materials shall be tested within the Continental United States by independent, nationally recognized testing agency and shall be listed in accordance with testing agency requirements.

B. The trade names or catalog numbers stated herein indicates the grade or quality of materials desired.

C. Dimensions, sizes, and capacities shown are a minimum and shall not be changed without permission of the University's Representative.

D. Conform to the State Energy Conservation Standards for all material and equipment.

2.02 MATERIALS FURNISHED

A. Identify all materials and equipment by manufacturer's name and model number. Remove unidentified materials and equipment from site.

B. Equipment specified by manufacturer's number should include all accessories, controls, etc. listed in catalog as standard with equipment. Furnish optional or additional accessories as specified.

C. Equipment or material damaged during transportation, installation, or operation is considered as totally damaged. Replace with new equipment. Variance from this permitted only with written consent of the University's Representative.

D. Welding materials and labor shall conform to ASME Code and applicable state labor regulations.

PART III - EXECUTION

3.01 DRAWINGS AND COORDINATION

A. General arrangement and location of piping, ductwork, equipment, etc. are shown on Drawings or herein specified. Carefully examine other work that may conflict with this work. Install this work in harmony with other crafts and at proper time to avoid delay of work.

B. In advance of construction, work out minor changes and relocations to suit actual conditions and work of other trades to avoid conflict therewith. This shall not be cause for additional cost.

C. Verify all measurements at the building and be responsible for the correctness of it. No extra compensation will be allowed on account of differences between actual dimensions and those indicated on the Drawings.

D. In addition, obtain all necessary information from the other trades regarding centers of partitions, walls, location of plumbing mains, fire sprinkler mains, and electrical conduits, ducts, pipes, etc. in order that pipes, equipment, and ductwork may be placed in their correct positions.

E. Execute any work or apparatus shown on the Drawings and not mentioned in the specifications, or vice versa, the same as if specifically mentioned by both. Omission from Drawings or specifications of any minor details of construction, installation, materials, or essential specialties does not relieve Contractor from furnishing it in place complete.

F. Furnish and install any incidental work not shown or specified which can reasonably be inferred as part of the work and necessary to provide a complete and workable system.

G. Furnish materials and work at proper time to avoid delay of the work.

H. The successful execution of this contract work includes compliance with two aspects of project quality assurance, installation quality control and system operational performance. In this scope of work, system operational performance focuses on the quality assurance of equipment, controls and systems. In addition to their own forces, Contractor will work with the test and balance and electrical testing agencies, respectively, to provide the University with documented evidence of commissioning/quality assurance for the mechanical and electrical portions of this project.

I. In addition to other requirements defined by the contract documents, or in the following paragraphs herein, the Contractor will be responsible for coordination and cooperation among the project team, inclusive of other subcontractors, and will provide trouble shooting of variances found to the intent of the design documents and provide execution of the resulting corrective measures. These efforts shall be expended at a minimum during the installation, the start up phase, the functional testing phase, and prior to system close out. All costs associated with the above, inclusive of re-testing of non-compliance items, shall be considered part of and included within the base contract amount.

J. Testing and balancing of the HVAC systems will be contracted directly by the University. The 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 subcontractor. With the exception of the actual labor of the test and balance contractor, the contractor shall consider specification section 15990 – Plumbing/HVAC Final Testing, Adjusting, and Balancing, to be an inclusive part of his contract documents and shall assume necessary compliance therewith, especially substantial completion. The 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.

3.02 ACCESS

A. Continuously check Drawings for clearance and accessibility of equipment specified herein to be placed. No allowance of any kind will be made for negligence on part of Contractor to foresee means of installing equipment into proper position.

3.03 CLOSING IN OF UNINSPECTED WORK

A. Do not allow or cause work installed to be covered up or enclosed before it has been inspected and tested. Should work be enclosed or covered up before it has been inspected and tested, uncover work at own expense. After it has been inspected and tested, make repairs necessary to restore work to condition in which it was found at time of cutting.

3.04 PROJECT MODIFICATIONS

A. During the progress of construction, if such conditions arise that require revisions, modifications, or relocations to any mechanical equipment or materials incorporated in this project, such alterations shall be immediately called to the attention of the University's Representative. Contractor shall then prepare necessary Drawings showing proposed changes. Submit proposed changes for review by the University's Representative prior to actual revision work in the field.

B. Two sets of Drawings showing all revisions shall be immediately presented to University's Representative for University records. Maintain additional copies on the project as necessary to comply with "RECORD DRAWINGS" requirement of the General Requirements.

C. Incorporate all revisions into Record Drawings.

3.05 FORMING, CUTTING AND PATCHING

A. Coordinate as necessary to provide any special forming, recesses, chases, etc., and provide wood blocking, backing, and grounds as necessary for proper installation of mechanical work.

B. If Contractor fails to coordinate at proper time or fails to locate items properly, resulting in extra work, then Contractor is responsible.

C. Contractor is responsible for proper placement of pipe sleeves, hangers, inserts, and supports for work.

D. Cutting, patching, and repairing of existing (old) construction to permit installation of piping, etc. is responsibility of this Contractor. Repair or replace damage to existing work with skilled mechanics for each trade involved in first-class manner.

E. Cut existing construction in a neat and workmanlike manner by the use of a concrete saw. Use of pneumatic devices will not be allowed.

F. Core openings through existing construction as required for the passage of new piping, ducts and conduits. Cut holes of the minimum dimension to suit size of pipe or duct installed and associated insulation.

3.06 ASBESTOS ABATEMENT

A. Existing systems within the area of this scope of work may have asbestos-bearing materials. Testing, encapsulation, removal, treatment, or correction of existing asbestos-bearing materials is not a part of this scope of work and is not the responsibility of the Contractor.

3.07 STRUCTURAL DESIGN OF EQUIPMENT AND SEISMIC RESTRAINTS

A. All mechanical equipment supports shall be designed by a licensed Structural Engineer and shall comply with the current Title 24, California Building Code requirements.

B. Provide all piping and ductwork with seismic restraints as called for in SMACNA's "Guidelines for Seismic Restraints of Mechanical Systems and Plumbing Piping Systems".

C. In addition, conform to all State of California requirements.

3.08 DEMOLITION AND SALVAGE

A. All fixtures, materials, and equipment not designated for re-use or to be turned over to the University, shall be placed in recycle or waste bins as directed by the Owner's Representative. No materials are to be removed from the project site without the express permission of the Owner's Representative.

3.09 EXISTING SERVICES

A. Provide and install all required connections to existing systems as required by the drawings and specifications.

B. Integrate existing systems with all new work to provide a complete working system.

C. Comply with the requirements as stated in Specification Section 01310 for service shutdown procedures.

3.10 WARRANTIES AND GUARANTEES

A. Refer to Specification Section 01780 for requirements.

B. Be responsible for damage to any part of premises during guarantee period caused by leaks or breaks in work furnished and/or installed under this section.

C. Replace refrigerant, lubricants, or gasses lost as result of defects, breaks, or leaks in work.

3.11 PROJECT RECORD DOCUMENTS

A. Refer to Specification Section 01780 for requirements.

B. Match all symbols and designations used in contract Drawings when preparing "Record" Drawings.

C. Indicate clearly and correctly all work installed differently from that shown, and maintain records up to date as work progresses. Include invert elevations of pipes below grade of floor, the floor lines, plugged wyes, tees, caps, exact locations and sizing of piping, location of valves, and the like. Dimension locations from structural points.

D. Properly identify all stubs for future connections as to locations and use by setting of concrete marker at finished grade in manner suitable to University's Representative.

3.12 PROJECT COMPLETION TESTS AND START-UP

A. Upon completion of the mechanical work and completion of the BACS point by point verification, or at such time prior to completion as may be determined by the University's Representative, operate and test all mechanical equipment and systems for a period of at least five consecutive 24-hour days to demonstrate the satisfactory overall operation of the building or project as a complete unit. Include operation of heating and air conditioning equipment and systems for a period of not less than five 24-hour days at not less than 90% of full specified heating and cooling capacities in tests. Commence tests after preliminary balancing and adjustments to the equipment and their areas served has been checked. Immediately before starting tests, install air filters and lubricate all running equipment. Notify the University's Representative at least seven calendar days in advance of starting the above tests.

B. The 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. Provide training and orientation of University's operating staff in proper care and operation of equipment, systems and controls to University's Representative's satisfaction.

D. Neatly tabulate and deliver to the University's Representative complete operational data. Airflows, temperatures, fan speeds, motor currents, static pressures, and other similar data will be supplied by air balance contractor hired by the University.

E. During test period, make final adjustments and balancing of equipment, systems, controls, and circuits so that all are placed in first-class operating condition.

F. Mark final positions of balancing valves after balancing is complete.

G. All areas of building shall receive proper flow of hot and chilled water to assure adequate and uniform temperatures throughout.

H. Final observation will not be made until all of the above have been completed and balance report has been submitted and reviewed.

I. Provide documentation of all tests as specified by this and other sections. Submit to the University's Representative in an electronic form (2 copies) and in hard paper form (2 copies). Compile the electronic copies (including graphics or drawings) entirely in the current version of Abode Acrobat complete with an interactive field linked Table of Contents (linked to the chapters and subsections within the report). Submit electronic copies on a CD (or CD's) prior to both Project Close Out AND application for Final Payment. Successful Project Close Out requires receipt and approval of the test documentation.

3.13 POST-CONTRACT COMPLETION TESTS

A. If the required full-load operation conditions cannot be obtained at the time of the Project Completion Tests due to outdoor seasonal temperatures, return to the job site when requested by the University's Representative and complete proper loading of equipment and systems as required. Changing of any air filters will not be required under these tests. Contractor will be allowed seven calendar days after notification to begin tests.

3.14 PRE-SEASON START UP

A. When requested by the University within one year of the filing of Notice of Completion, and when full-load tests required under Project Completion Tests and Post Contract Completion Tests have not been performed, start up any equipment or systems required for heating or cooling season operation by the University when such equipment and systems have remained shut down immediately after the Project Completion Tests. Make proper assurance that all equipment and systems are operating properly before being turned over for the first operational use of the University within one year of filing of Notice of Completion. The changing of any air filters will not be required under these start-up requirements. The Contractor will be allowed seven (7) calendar days after notification, to begin test.

3.15 CLEAN UP

A. Upon completion of Work remove materials, equipment, apparatus, tools, etc., and leave premises clean, neat, and orderly.

END OF SECTION

SECTION 150500
BASIC MECHANICAL MATERIALS AND METHODS

PART I - GENERAL

1.01 WORK INCLUDED

A. Types of mechanical related work specified in this section include the following:

1. Roof and Wall Flashing
2. Pipe Identification
3. Thermometers
4. Gauges
5. Belt Drives and Guards
6. Electrical Motors and Motor Starters

1.02 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data in accordance with requirements of Specification Section 01330.

B. Equipment Data and Operation and Maintenance Instructions: Submit in accordance with Specification Division 1 and 150100 requirements.

PART II - PRODUCTS

2.01 FLASHINGS IN MEMBRANE TYPE ROOFING

A. Flashing for penetrations of the roof for mechanical items such as flues, ducts, and pipes will be furnished and installed under other sections of these specifications. The work of this section shall include layout, sizing, and coordination of penetrations required for the mechanical work.

1. Furnish and install counter flashings above each flashing required in the mechanical work. Flues and ducts shall have 24-gauge galvanized sheet metal storm collar securely clamped to the flue above the flashing.
2. Sewer vents and other piping extending through roof structure shall have flashing and counter flashings provided and installed as part of the roofing work. Contractor shall coordinate Work accordingly.

B. Sewer vents and other piping extending through roof structure shall not contain any lead materials and shall be Thaler, Smith, or equal, counter flashing sleeves installed as detailed.

2.02 THERMOMETERS

A. All thermometers, unless shown otherwise, shall be of the bimetal helix or liquid-filled type, Weston, Marshal Town, or equal. All thermometers shall be round, stainless steel case construction with glass front and shall be accurate within plus or minus one of the smallest scale divisions throughout the entire range. The thermometer scales shall have a minimum of 2º between graduations and a maximum of 20º between figures. The

thermometers shall be located so as to be easily read and shall be furnished with adjustable angle pattern so as to be rotated to any position. Each thermometer shall have ⅜" minimum IPS ball valve installed to isolate the thermometer or install thermometer in well.

B. Thermometers used for air temperature in ductwork, plenum boxes, etc., unless specified or shown otherwise, shall have a minimum scale face of 5" and shall have an adjustable mounting flange so that scale may be set at any angle up to 45º to facilitate reading.

1. The thermometers shall have a perforated guard over stem suitable for sensing air temperature.
2. Length of stem shall be a minimum of 8".

C. Thermometer wells with chain and cap shall be provided where wells are indicated on the Drawings.

2.03 GAUGES

A. Gauges and gauge connections shall be furnished at all locations shown on the Drawings and in accordance with these specifications, whether shown on the Drawings or not.

B. Gauges shall be of high quality, with accuracy to be within 1% in the middle third of the dial range and equipped with front calibration. Gauge movements shall be phosphor bronze, bushed, rotary type. Gauges mounted on panel boards shall be the flush-mounting type in cast-iron or aluminum cases. Stem or pipe mounted gauges shall have flangeless cases of drawn or stamped steel, phenolic, or aluminum. Gauges shall have a minimum dial size of 3-½". Gauges shall be installed with IPS ball valves ⅜" or larger S.O.V. for replacement or repair of gauge. Gauge to be installed with a pigtail to minimize gauge fluctuation.

2.04 PIPING AND EQUIPMENT IDENTIFICATION

A. Each piping system furnished and installed under this work shall be identified and the direction of flow indicated by means of colored stenciled legends and flow arrows, all as specified herein. The markings shall be applied after all painting, priming, and cleaning of the piping and insulation is completed. Label every 20' of actual length and in every room. At valve access doors or lift outs, identify piping and valves.

B. In lieu of the colored stenciling, prefabricated labels on paper or on pressure sensitive self-adhesive cloth tapes may be used, as manufactured by General Painting Company, Westline Products, or equal. The labels shall have black lettering and flow arrows on colored backgrounds, and the background colors shall conform to the color schedule shown in this Article. Yellow letters may be used on brown background only for better visibility. If the paper labels are used, they shall be attached to the piping with Arabol Adhesive No. E-3448, or equal. After the adhesive has dried, the paper label shall be given a protective coating of Arabol No. E708F, or equal.

1. The size of the lettering and label shall be such that the lettering can be easily read from the floor and the colors are easily discernible.

C. Provide white lamacoid plate for each and every piece of equipment installed in this work. Lettering on plate shall be black, with size of lettering to suit equipment. Lettering shall be minimum of ⅜" in height. Plates shall be riveted or bolted to equipment.

D. At completion of project, Contractor shall submit a valve listing for all valves installed on the project. All valves shall be tagged with 2" diameter brass tags noting valve number and contents in the pipe. Valve listing shall note valve tag number, contents in the pipe and the areas (room numbers, etc.) that are impacted when valve is in the closed position. Separate lists shall be made for the plumbing and mechanical systems. Valve listing sheets shall be 8-½ x 11" installed in a frame with glass cover and suitable for hanging in an area selected by the University's Representative.

1. Provide Bakelite tags at areas where valves (equipment) are concealed above ceiling or behind access doors. Tags to describe concealed valves (equipment). Color code identification for plumbing shall be blue/HVAC-yellow/Electrical-green/Fire-red.

2.05 ELECTRIC MOTORS

A. Electric motors of more than ½ HP rating shall be, unless otherwise noted, ball-bearing, open (drip- proof), squirrel cage, induction type, normal starting torque, 3-phase, 60-cycle service, 40ºC continuous rating, and shall conform in all respects to latest applicable standards of NEMA and AIEE. Motors shall be Baldor, Century, or equal.

1. Motors located outdoors shall be TEFC type.

B. All motors of 1 HP and above shall be premium efficiency type, Century E-Plus, or equal, no known equal.

C. Motors shall have nameplate voltage rating of operating voltage specified in subsequent sections of specifications or as shown on Drawings and shall have a 1.15 service factor.

D. For normal application, motors shall be furnished for normal starting torque duty. It shall be Contractor's responsibility, however, to provide motors and starters having suitable starting torque and current characteristics to allow starting (where starters are furnished under this section) the equipment within the branch circuit protection provided and within the overload protection required by codes.

E. Splash proof or totally enclosed motors having a continuous-duty temperature rise rating not exceeding 35ºC. shall have adequate starting torque, as recommended by the manufacturer, for the service intended.

F. Shaft Grounding: VFD powered small AC motors (less than 300 hp) shall have a single shaft grounding system to protect the bearings from capacitive discharge through the bearings. The shaft grounding system shall be CR Series as manufactured by Shaft Grounding Systems, Inc., or equal. The shaft grounding system shall reduce the shaft to frame voltage below 3 volts (as measured with Fluke 97 oscilloscope), have low drag, be field installable with hand held tools, sealed to be resistant to weather and contaminants and require no periodic adjustments or maintenance for a normal running life of five years at speed up to 1800 rpm. The grounding brush element must be changeable without shutting the motor down or using special tools. Isolated bearings are an acceptable alternate to shaft grounding.

2.06 ELECTRIC MOTOR STARTERS

A. If supplied, Contractor shall coordinate magnetic motor starters for equipment provided under the Mechanical Work such that they shall be furnished as part of the Mechanical Work and incorporated into the Electrical Work for installation, unless otherwise noted.

B. Unless otherwise noted, starters shall be furnished in NEMA 1 enclosure for inside installation and casketed NEMA 4 enclosure for outside installation, with three thermal overloads for three-phase motors and one overload element for single-phase motors. All overloads shall be ambient compensated.

C. Combination magnetic starters shall be GE or Square D with circuit breaker disconnects, trip size of breaker as required for motor size, or equal.

D. Magnetic motor starters shall be GE, Square D or equal.

E. Manual motor starters shall be GE or Square D, less enclosure, or equal.

F. Magnetic motor starters shall be provided with cover-mounted H.O.A. "OIL-TIGHT" type devices as scheduled and integral, fused, 120-volt, single-phase control transformers.

G. All starters shall be by same manufacturer, General Electric, Square D., or equal.

2.07 BELT DRIVES

A. Belt drives for fans and equipment shall consist of "V" belts and sheaves. No adjustable sheaves allowed.

B. Rating: Belt drives shall have a minimum horsepower rating, at designed speeds of 1.5 times the motor nameplate horsepower rating.

C. Construction: Sheaves shall be cast iron and shall be machined and balanced. Sheaves shall be keyed to the shaft and locked with Allen-type set screws.

D. Sheaves shall have pitch diameter of not less than the following sizes for the belt sections to be used.

1. *FHP - Section Belt 2.0” minimum P.D.
2. A - Section Belt 3.0” minimum P.D.
3. B - Section Belt 5.4” minimum P.D.
4. C - Section Belt 9.0” minimum P.D.
5. D - Section Belt 13.0” minimum P.D.
6. *Fractional Horsepower.

E. Belts shall be furnished in matched sets.

F. Fan Drives: Fan drives for blower-type fans shall be selected for the proper fan speeds required for the air volumes specified or shown on the Drawings at the static pressures indicated. The static pressures indicated show estimated conditions, which may vary under actual operating conditions. Should it be necessary to adjust the fan speeds to obtain the proper air volume, the Contractor shall make the necessary changes to the drives without additional cost to the University.

1. Inlet vanes or variable pitch blades shall not be used to adjust air quantities at initial balance of the system.

2.08 GUARDS

A. Belt drives, gear drives, shafts, couplings, fan inlets, and running equipment shall be properly protected by guards, whether shown on the Drawings or not, all as required by local codes.

B. Construction: Belt guards shall be of all metal construction with angle iron framework. Guards for belt drives shall have a removable section held in place with studs and wing nuts for easy replacement of belts. Openings shall be provided at shaft ends for taking RPM readings. Belts shall be guarded on both sides of the drives.

C. Coupling guards shall be No. 10 gauge steel minimum.

PART III - EXECUTION

3.01 INSTALLATION OF EXPANSION ANCHORS

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

B. Job testing: Load test 50% of the post-installed anchors on each job. See structural drawings for detailed information on testing and inspection of post-installed anchors.

3.02 INSTALLATION OF THERMOMETERS

A. Liquid thermometers for piping systems shall be installed so that the liquid flows completely around the bulb. Pipe sizes at the bulb shall be increased where necessary to allow for full flow without excessive resistance.

B. Where shown on the temperature control diagram, the Contractor shall furnish and install remote, bulb, panel-mounted, pneumatic-type thermometers. Duct-mounted thermometers may be omitted at these locations.

C. Locations: Thermometers shall be placed at all locations shown on the Drawings and at locations specified below. Ranges shall be as specified below.

Location	**Range Degrees F**
Air inlet and outlet of each Bank of heating and cooling coils.	30 to 120ºF
Adjacent to each insertion type thermostat installed (Hot Water) under "Temperature Control."	+50 to 250ºF
Thermometer bulb to be installed adjacent to bulb (Chilled Water) of insertion thermostat.	+30 to 130ºF
In supply and from tank and return of domestic hot water systems near circulating pump.	30 to 180ºF
In both the water inlet and water outlet of each bank of hot water and chilled water coils and heat exchangers.	+50 to 300ºF +25 to 125ºF (Chilled Water)

D. In such cases where the above described thermometers cannot be located so as to be easily read, a remote reading type of thermometer shall be installed, as approved by the University's Representative.

E. Thermometers provided as part of the temperature control work and located on a control panel, etc. need not be duplicated by above requirements.

3.03 INSTALLATION OF GAUGES

A. Gauges shall have indication of 0 to 160 psi where indicated pressure will be greater than 40 PSI and 0 to 60 psi for lesser pressures.

B. Provide gauge connections at the following locations:

1. Inlet and outlet of butterfly-type balancing valves.
2. Inlet and outlet of water chiller.
3. Suction and discharge of circulating pump.
4. Elsewhere as may be shown on the Drawings.

C. Gauges shall be provided in a convenient location within approximately 5 feet of the flanges or connections and elsewhere as may be shown on the Drawings.

D. Gauge Cocks and Siphons:

1. A full port ball valve, or equal, no known equal, shall be supplied at each gauge and gauge connection.

    a. A gauge siphon located adjacent to the gauge shall be applied with each hot water gauge.

3.04 PIPE IDENTIFICATION

A. Identification shall be applied to all piping, except piping located in furred spaces without access to permit entrance of personnel, and piping buried in the ground or concrete.

B. The legend and flow arrow shall be applied at all valve locations, at all points where piping enters or leaves a wall, partition, cluster of piping, or similar obstruction, and at approximately 20-foot developed length intervals on pipe runs.

C. Practical variations or changes in locations and spacing may be made with the specific approval of the University's Representative to meet specific conditions.

D. Wherever two or more pipes run parallel, the printed legend and other markings shall be applied in the same relative location so that all piping is easily identified.

E. The marking shall be located so as to be readily conspicuous at all times from any reasonable point of vantage.

F. The legends and flow arrows shall be in the colors as indicated in the pipe marking schedule.

G. The paint shall be prepared enamel brushed on or sprayed from pressurized cans.

H. Where the pipe marking colors are not easily visible over the background, such as brown on soil pipe, orange on copper pipe, or similar combinations, a neat white or aluminum-colored background shall be painted on the pipe before the markings are applied.

I. Label and tag valves and piping at access doors.

J. On medical gas, the oxygen piping will be labeled the entire length of the pipe in attics, walls, below floor, etc.

K. Color Coding: All medical oxygen piping shall be labeled every 10’ from one end to the other, this includes drops in walls that are sleeved, all overhead piping, etc. All painting shall consist of first quality products. Paint shall be W. P. Fuller, Devoe, or equal. Surface shall be thoroughly cleaned and dry. First coat shall be completely dry before applying second coat.

L. The sizes, in inches, of the stenciled lettering and flow arrows shall be as follows:

Outside Diameter, In Inches of Pipe or Covering	Size of Stencil Letter	Minimum Length of Flow Arrow
⅝" to 2" incl.	½"	2-½"
2-½" to 4" incl.	1"	4"
4-½" to 7" incl.	2"	5"
8" and larger	3"	6"

M. Where different equipment, such as fire sprinklers, are supplied from a common main, such as domestic water, the main should be identified as "Domestic Water" and each respective branch takeoff as "Fire Water," etc.

N. Markers shall be Brady "PIPE MARKERS" color code as per Pipe Markers self sticking Vinyl pipe markers.

Pipe Marking Schedule:

Legend	Color
Domestic Water	Green
Hot Water - Domestic Supply	Yellow
Hot Water - Domestic Return	Yellow

3.05 ELECTRICAL WORK

A. Adequate working space shall be provided around electrical equipment in compliance with the National Electric Code and other applicable codes or ordinances. The mechanical work shall be coordinated with the Electrical Work in order to comply with these requirements. Any work which does not conform to these regulations shall be properly corrected without additional cost to the University.

B. Furnish and install all line voltage and low-voltage temperature control wiring in the Mechanical Work by the Temperature Control Subcontractor, including all interlock wiring between motor starter coils, interlock relays, and temperature control equipment. Unless noted otherwise, this does not include primary control wiring between starters and push button or other manual starter switch or branch power circuits required for temperature control systems.

1. Starters located in motor control centers will be provided under the Electrical Work. Contractor is referred to electrical drawings for motors served by motor control centers.
2. Motors and VFDs furnished under Mechanical Work shall be installed under Electrical Work. Contractor to coordinate all motor starter and VFD requirements.
3. Temperature control equipment, including relays shown on control diagram, shall be furnished and installed by the Temperature Control Contractor.
4. Electrical devices with piping connections, such as solenoid valves, insertion thermostats, strap-on aqua stats, and similar items, which are to be wired under the Electrical Work or by the Temperature Control Contractor, shall be installed under Mechanical Work.

C. Equipment furnished in this work that is factory wired but requires modification to internal wiring to meet specifications or drawing requirements shall have such internal modifications made at factory before shipment.

D. All electrical work and equipment, including internal wiring, must comply with applicable codes and applicable portions of electrical specifications. Run line and low-voltage control wiring in conduit. Conduit for temperature control wiring shall be part of mechanical work and shall be of type specified in electrical specifications.

3.06 FLASHINGS

A. Flues and ducts shall have 24-gauge galvanized sheet metal storm collar securely clamped and sealed above flashing.

3.07 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 that are installed as part of this work. Leave systems and equipment in satisfactory operating condition.

B. Drain and flush piping to remove grease and foreign matter. Thoroughly clean out flush valves, traps, strainers, and pressure-reducing valves.

C. Keep the interior of all ductwork free of dirt, dust, loose insulation, and other foreign materials at all times.

D. Clean out and remove surplus materials and debris resulting from the work, including surplus excavated material.

END OF SECTION

SECTION 150600
PIPES AND PIPE FITTINGS

PART I - GENERAL

1.01 WORK INCLUDED

A. Types of piping systems and specialties specified in this section include the following:

1. Copper Tube
2. Miscellaneous Piping Materials/Products

1.02 QUALITY ASSURANCE

A. Welders' Qualifications:

1. Welding: Qualify welding procedures, welders and operators certified in accordance with ASME B31.1, or ASME B31.9, as applicable, for shop and project site welding of piping Work.
2. Copper Brazing (including medical gas pipe & fittings):

a. Certified yearly by P.I.P.E., or agency that meets AWS B2.2-85 Brazing Procedure, American Welding Society Standards.

b. Show current brazing certifications upon request.

c. Certification shall be copied and provided to University's Representative to be kept on file by University's Plant Operations and Maintenance Plumbing Supervisor for duration of the job.

B. Manufacturers: Firms regularly engaged in manufacture of supports and anchors of types and sizes required, whose products have been in satisfactory use in similar service for not less than five years.

C. Requirements of Regulatory Agencies:

1. Comply with applicable codes pertaining to product materials and installation of supports and anchors.
2. UL and FM Compliance: Provide products which are Underwriters Laboratories listed and Factory Mutual approved.

1.03 SUBMITTALS

A. Product Data: Submit catalog cuts, specifications, installation instructions, and dimensioned Drawings for each type of support, anchor, and seal listed in this Section.

B. Welding and Brazing Certifications: Submit reports as required for piping Work.

C. Installers must posses needed skills and background to successfully install and complete a medical gas-medical vacuum system. Installers of medical gas-medical vacuum piping, fittings, and flexible loops shall be a certified medical gas-medical vacuum installer, current certification required. Certification shall be copied and provided to University's Representative to be kept on file by University's Plant Operations and Maintenance Plumbing Supervisor for duration of the job.

PART II - PRODUCTS

2.01 GENERAL

A. Provide pipe and tube, joint type, grade, size, and weight indicated for each service, and comply with governing regulations and industry standards.

2.02 COPPER TUBE AND FITTINGS

A. No type "M" copper pipe to be used on building systems, "L" or "K" only. Use only type "K" below ground, all joints below ground to be brazed.

1. Supply water piping to fixtures and equipment shall be a minimum of ¾" pipe size, unless indicated otherwise on the drawings.

B. DWV Copper Tube: ASTM B 306.

C. Wrought-Copper Solder-Joint Fittings: ANSI B16.22.

D. Wrought-Copper Solder Joint Drainage Fittings: ANSI B16.29.

2.03 HANGERS AND SUPPORTS

A. Vertical Piping:

1. Support vertical piping risers securely with riser clamps, Tolco Fig. 6, or equal. Attach clamps to the pipe above each concrete floor slab, with the arms of the clamp resting on the slab or the structural supports.
2. Support pipelines passing up through the building at each floor of the building.

B. Horizontal Piping:

1. Pipe hangers shall be Tolco, Grinnell, Super Strut, or equal.
2. Use Tolco Fig. 3, or equal, steel strap hanger for uninsulated steel or cast-iron pipe through 8” size, and for insulated steel or cast-iron pipe through 4” size. Use Tolco Fig. 1, or equal, steel hanger in pipe sizes where suitable. Use saddle shield as specified for insulated pipes.
3. Use cushioning clamps when using unistrut.

C. Pipe Saddles:

1. Insulation shall be protected by USS No. 18 gauge galvanized steel shield, with a minimum length of 8”.
2. Pipe saddles shall be Insul-Shield by Tolco multipurposed pipe saddles manufactured by Insul-Coustic Corporation, Thermal Hanger Shields by Pipe Shields, Inc., or equal.

3. Concrete Inserts: Provide Hilti, Tolco, or equal.

PART III - EXECUTION

3.01 INSTALLATION OF PIPING

A. Install pipes and pipe fittings in accordance with recognized industry practices which will achieve permanently leakproof piping systems, capable of performing each indicated service without piping failure. Install each run with minimum joints and couplings but with adequate and accessible unions for disassembly and maintenance/replacement of valves and equipment. Reduce sizes where indicated by use of reducing fittings. At locations where a reduced fitting is required, contractor shall use factory reducing fittings or bell reducers, do not use bushings. Align piping accurately at connections, within $^{1}/_{16}$" misalignment tolerance.

B. Comply with ANSI B31 Code for Pressure Piping.

C. Locate piping runs, except as otherwise indicated, vertically and horizontally (pitched to drain), and avoid diagonal runs wherever possible. Orient horizontal runs parallel with walls and column lines. Locate runs as shown or described by diagrams, details and notations, or if not otherwise indicated, run piping in shortest route which does not obstruct usable space or block access for servicing building and its equipment. Hold piping close to walls, overhead construction, columns, and other structural and permanent-enclosure elements of building; limit clearance to ½" where furring is shown for enclosure or concealment of piping; locate insulated piping for one-inch clearance outside insulation. Wherever possible in finished and occupied spaces, conceal piping from view by locating in column enclosures, in hollow wall construction, or above suspended ceilings; do not encase horizontal runs in solid partitions, except as indicated.

D. Electrical Equipment Spaces: Do not run piping through transformer vaults and other electrical or electronic equipment spaces and enclosures. Install drip pan under piping that must be run through electrical spaces and in all other locations indicated on Drawings.

E. Should structural difficulties or Work of other Contractors prevent the running of pipes or the setting of equipment at the points shown, the necessary deviations there from, as determined by the Contractor, with the University's review, will be allowed but shall be made without additional cost to University.

F. Inspect each piece of pipe and each fitting to see that there is no defective workmanship on pipe or obstructions in pipes and fittings.

G. Install exposed polished or enameled connections from fixtures or equipment with special care, showing no tool marks or threads at fittings.

H. Cap or plug openings in pipe and fittings immediately to exclude all dirt until fixtures are installed or final connections made.

I. Use reducing fittings where any change in pipe size occurs. Bushings shall not be used.

J. Couplings shall not be used except where required pipe runs between fittings are longer than a standard length of the type of pipe being used and except where their use is specifically reviewed by the University's Representative.

K. Conceal piping in finished portions of building, above the floor line, except where otherwise shown or noted. Cutting of walls and floors shall be held to the minimum possible to secure the proper installation.

L. Install piping subject to expansion or contraction in a manner permitting strains to be evenly distributed and alleviated by expansion loops installed as required.

M. Sleeves for branches through walls from adjacent mains shall be of sufficient size to allow for free side motion of covered pipe in sleeve.

N. Grade water circulating piping used for space heating and/or cooling up to high points at the rate of ¼" in 10' in the direction of flow with returns grading down at same rate. Air vent valves specified hereinafter shall be installed at high points. Changes in pipe sizes shall be made with eccentric reducers flat on top.

O. Condensate Drain Piping: Run piping with pitch as shown, without pockets.

P. Install low point drains on all piping at the lowest point in the system to enable the total drain down of the system for the purpose of repairs, retrofits or remodels. Lines from 4" through 10" pipe shall have a 2" low point drain and 2" SOV. Lines 2" through 3-½" shall be a 1-½" low point drains and 1-½ SOV. Smaller size lines use line size low point drains and SOV's. Include plugs in end of shutoff valves. Drain valves shall be 800 lb. Full port gate valve on 240º heating hot water systems.

Q. Manual Air Vent: At all high points and all coils, furnish a manual air vent with SOV. Assembly shall consist of a ½" IPS ball valve and ½" gooseneck pipe of same material as piping.

3.02 INSTALLATION OF PROTECTIVE PIPE WRAP

A. Protect all steel pipe buried in ground from corrosion by the application of protective pipe wrap. Clean and prime pipe before application of the wrapping material. Use leak detector to locate breaks in pipe insulation - then repair.

3.03 INSTALLATION OF HANGERS AND SUPPORTS

A. General:

1. Fasten all piping securely to building construction with hangers, supports, guides, anchors, or sway braces to maintain pipe alignment, to prevent any sagging, and to prevent noise or excessive strain on the piping due to uncontrolled movement under operating conditions. Relocate hangers and/or add as necessary to correct unsatisfactory conditions that may become evident when system is put into operation. All piping shall be independently supported from the building structure. No piping shall be used to support other piping.
2. Follow drawing requirements and details where special pipe support requirements are detailed on the Drawings.

3. Do not support piping by perforated tape, wire, rope, wood, nails, or other makeshift devices.
4. Design hangers and supports to support the weight of the pipe, weight of fluid, and weight of the pipe insulation with a minimum factor of safety of five based on the ultimate tensile strength of the material used.
5. Burning or welding on any structural member under load shall not be attempted. Field welding not called for on the Drawings or reviewed shop Drawings may only be done with consent and advice of the University and after proper provisions have been made to relieve the stress on the member. The boring of holes in beam flanges or narrow members will not be allowed.
6. Install hanger on insulated piping in a manner which will not produce damage to insulation. Provide steel pipe saddles as required to protect pipe covering. Install pipe hangers on piping covered with insulation on the outside of the insulation and not in contact with the pipe.
7. Fasten hanger rods to concrete structural members with concrete inserts set flush with surface. Install a reinforcing rod through the opening provided in the concrete inserts. Fasten hanger rods to structural members with suitable beam clamps, and provide beam clips to lock clamp securely to beam.
8. Use of powder-actuated fasteners will not be permitted for the support of any overhead piping.
9. Turnbuckles, if used, shall have a load-carrying capacity at least equal to that of the pipe hanger with which they are being used.
10. All threaded parts of pipe hanger assemblies shall have full length of thread in service while in use.
11. All hangers, hanger supports, hanger trapeze supports, fire piping hangers and strut supports shall have one nut on top and double nutted below.

B. Pipe Hanger or Support Spacing:

1. Provide pipe hangers or supports at 6’ maximum spacing on steel pipe 1” diameter and smaller and for copper pipe 1-½” and smaller Tolco.
2. Support steel piping larger than 1” and copper larger than 1-½” at 10’ maximum spacing.
3. Provide hangers or supports for horizontal cast-iron soil pipe at every other joint, except that when the developed length between hangers exceeds 4’, provide hangers at each joint. Spacing of hangers shall not exceed 5’. Provide adequate sway bracing to prevent shear. Horizontal cast iron piping (waste and vent) shall have hangers installed on each side of piping and fitting joints. Hangers shall be within 18" of the joints. On horizontal and vertical piping and fittings, use felt pad vibration isolators, Superstrut 715 and 716, Semco Trisolators, or equal. Do not use felt pad isolators without metal or plastic shield.

3.04 PIPING SYSTEM JOINTS

A. General: Provide joints of type indicated in each piping system.

B. Cut all steel pipe and hard copper tubing by power hacksaw, a circular cutting machine using an abrasive wheel or in square end vise by means of hand hacksaw. Wheel cutters may be used for steel pipe provided that pipe shall have ends reamed to full inside diameter and beveled before being made up into fittings. Pipe shall have round edges or burrs removed so that a smooth and unobstructed flow will be obtained.

C. Thread pipe in accordance with ANSI B2.1; cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Apply pipe joint compound, Rector-Seal #5, or equal, on male threads at each joint and tighten joint to leave not more than 3 threads exposed. Teflon tape may be used on piping smaller than 2".

D. Use joint compound, same as specified for threaded pipe joints, on all cleanout plugs.

E. Braze copper tube-and-fitting joints where indicated, in accordance with ASME B31.

F. Solder copper tube and fitting joints where indicated, in accordance with recognized industry practice. Cut tube ends squarely, ream to full inside diameter, and clean outside of tube ends and inside of fittings. Apply solder flux to joint areas of both tubes and fittings. Insert tube full depth into fitting, and solder in manner which will draw solder full depth and circumference of joint. Solder shall be 95% tin, 5% antimony and shall be used above grade only. Wipe excess solder from joint before it hardens.

G. Branch tees in copper tubing, provided that branch size is one-half the size of the main or smaller, may be made with Bonney Brazolets, or equal, with socket, or threaded outlets as required, and with factory-furnished curvature and socket dimensions for the specific type of copper tubing on which it is to be used. Make up joint between the "Brazolet" and the main with silver brazing alloy, as specified. No tapping of schedule 40 or schedule 80 pipe for air vents, petes plugs, etc. Install fittings or weld on ¼" steel couplings or thread-o-lets.

1. No tee to be pulled. No stub-ins. No pipe saddles.

H. Weld pipe joints in accordance with recognized industry practice and as follows:

1. Welding shall be done by qualified welders in a first-class, workmanlike manner, conforming to the American Standard Code for Pressure Piping USA B-31-1 and B-31-1A.
2. Bevel pipe ends at a 37.5º angle where possible, smooth rough cuts, and clean to remove slag, metal particles, and dirt.
3. Do not weld-out piping system imperfections by tack-welding procedures; re-fabricate to comply with requirements.

I. Install forged branch-connection fittings wherever branch pipe of two pipe sizes smaller than main pipe is indicated; or install regular "T" fitting.

J. Flanged Joints: Match flanges within piping system and at connections with valves and equipment. Clean flange faces and install gaskets. Tighten bolts to provide uniform compression of gaskets.

K. Hubless Cast-Iron Joints: Comply with coupling manufacturer's installation instructions and in accordance with CISPI Pamphlet No. 100, latest edition.

1. Cast iron waste lines below ground, below floor, and in ceilings to be stainless steel four band no-hub Husky bands minimum as required by pipe size, or equal. Standard stainless steel two band no-hub bands to be used on vent systems only.
2. Make joints between cast-iron and steel pipe same as above with special adapter as required.

3.05 TEST OF PIPING

A. Test piping at completion of roughing in, in accordance with the following schedule and show no loss in pressure or visible leaks after a minimum duration of four hours at the test pressures indicated.

TEST SCHEDULE SYSTEM TESTED	TEST PRESSURE PSIG	TEST WITH
Condensate Drain Piping	Before backfilling fill with water to top of highest vent, allow to stand 2 hrs. or longer as directed by inspector.	Water
Chilled Water Piping	150 lbs. rough-in. 150 lbs. after equipment connection.	Water

B. Testing equipment, materials, and labor shall be furnished by Contractor.

C. Repair piping systems sections which fail required piping test, by disassembly and reinstallation, using new materials to extent required to overcome leakage. Do not use chemicals, stop-leak compounds, mastics, or other temporary repair methods.

D. Drain test water from piping systems after testing and repair work has been completed.

3.06 CLEANING UP

A. Upon completion of Work remove materials, equipment, apparatus, tools, and the like, and leave premises clean, neat, and orderly.

END OF SECTION

SECTION 151000
VALVES AND PIPING SPECIALTIES

PART I - GENERAL

1.01 WORK INCLUDED

A. Types of piping specialties specified in this section include the following:

1. Fully ported IPS or Flange bodies only; no solder joint valves.
2. Pipe Escutcheons
3. Pipeline Strainers
4. Sleeves
5. Sleeve Seals
6. Unions and Flanges

B. Types of valves specified in this section include the following:

1. All valves shall be I.P.S. only, no solder joint valves.

C. Balance Valves Drain Valves

Butterfly Valves Check Valves

Ball Valves

1. All shutoff valves in ground on UCD Medical Center property shall open by turning to the left or counter clockwise, city valves open by turning to the right or clockwise.

1.02 QUALITY ASSURANCE

A. Manufacturers Qualifications: Firms regularly engaged in manufacturing of plumbing piping systems products, of types, materials and sizes required. Whose products have been in satisfactory use in similar service for not less than five (5) years. On changes, submittals, etc., Contractor shall supply needed documents to support the manufactures' qualifications.

B. Valve Types: Provide valves of same type by same manufacturer.

C. Identification: Provide piping specialties and valves with manufacturer's name (or trademark) and pressure rating clearly marked on valve body.

D. Requirements of Regulatory Agencies:

1. UL and FM Compliance: Provide valves used in fire protection piping which are UL listed and FM approved.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of manufactured piping specialty and valve.

1. Include pressure drop curve or chart for each type and size of valve, control valve and balancing valve.

B. Maintenance Data: Submit maintenance data and spare parts lists for each type of manufactured piping specialty and valve. Include this data and product data in maintenance manual in accordance with requirements of Division 1.

PART II - PRODUCTS

2.01 MATERIALS

A. Provide factory-fabricated piping specialties and valves recommended by manufacturer for use in service indicated. Provide piping specialties of types and pressure ratings indicated for each service, or if not indicated, provide proper selection as determined by Contractor to comply with installation requirements. Provide sizes and connections which properly mate with pipe, tube, and equipment connections. Where more than one type is indicated, selection is Contractor's option.

B. Unless otherwise indicated, provide valves of same size as upstream pipe size.

2.02 PIPE ESCUTCHEONS

A. Provide chrome plated brass pipe escutcheons with inside diameter closely fitting pipe outside diameter or outside of pipe insulation where pipe is insulated. Select outside diameter of escutcheon to completely cover pipe penetration hole in floors, walls, ceilings, or pipe sleeve extension, if any. Furnish pipe escutcheons with nickel or chrome finish and screw or spring clamping device with concealed hinge.

B. Manufacturers: Chicago Specialty Manufacturing Company, Producers Specialty and Manufacturing Corporation, Sanitary-Dash Manufacturing Company, or equal.

2.03 PIPE SLEEVES

A. Where pipes pass through concrete floors or walls, install galvanized metal or plastic sleeves having not less than ½” or more than 1” clearance around sides of the pipe or pipe covering for the full thickness of the concrete.

1. After piping has been installed, fill annular space with fireproof safing.

B. Manufacturers: Adjustocrete, Sperzel "Crete-Sleeve", or equal.

2.04 SLEEVE SEALS

A. Provide sleeve seals for sleeves located in foundation walls below grade or in exterior walls as follows:

1. Walls and Floors: Modular-mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

B. Manufacturers: Link-Seal Corporation - Thunderline Corporation, or equal.

2.05 UNIONS AND FLANGES

A. Furnish and install unions at each threaded connection to all equipment, tanks and valves, of type specified in following schedule:

Type of Pipe	Union
Steel pipelines, 2" and smaller	250 lb. screwed malleable ground joint, brass to iron seat, black for black pipelines, galvanized for galvanized lines.
Copper tubing, 1-¼" and smaller	250 lb. bronze ground joint, bronze to bronze sweat connection.
Copper tubing, 1-½" and larger	250 lb. cast bronze, flat faced flange with silver brazing threadless ends.

B. Insulating couplings or flanges shall be furnished and installed at all connections of piping with dissimilar materials. Construct couplings so that the two pipes being connected are completely insulated from each other with no metal-to-metal contact. Heavily line the couplings with a hard, insulating, phenolic threaded coupling in standard pipe sizes.

C. Furnish and install flanges at each flanged connection to equipment, tanks, and valves per following schedule:

Type of Pipe	Flanges
Screwed black steel pipelines, 2-½" and larger.	125 lb. cast-iron screwed flange flat faced black.
Welded steel pipe, 2-½" and larger.	150 lb. forged steel welding flanges, $^{1}/_{16}$" raised faced, unless noted otherwise.

D. Provide full faced or ring type gasket material to suit facing on flanges per following schedule:

Service	Type
Cold Water	$^{1}/_{16}$" thick rubber Garlock #22, or equal, no known equal.
Hot Water	$^{1}/_{16}$" thick Flexataulic gasket, or equal, no known equal.
Steam	$^{1}/_{16}$" thick Flexatalic, or equal, no known equal.
Gas	$^{1}/_{16}$" thick Garlock #7986, or equal, no known equal.

2.06 EXPANSION JOINTS

A. Combination Couplings and Nipples: Provide expansion joints constructed of cut, grooved, short pipe nipples and couplings, designed by manufacturer to suit intended service. Provide removable ties to hold joint compressed or expanded during piping fabrication, depending on application. Select standard weight couplings and gasket materials to match balance of piping system. Provide at least three couplings at each expansion joint indicated on Drawings as recommended by manufacturer.

B. Manufacturers: ITT Grinnell, Stockham Valves and Fittings, Inc., Vitaulic Company of America, or equal.

2.07 FLEXIBLE CONNECTIONS

A. Use stainless steel double braided flexible connections for all flexible connections. Metraflex, or equal.

2.08 HIGH AND LOW-PRESSURE, Y-TYPE PIPELINE STRAINERS

A. Provide strainers full-line size of connecting piping, with ends matching piping system materials and cast-iron body. Select strainers for 250 psi (high pressure) and 125 psi (low pressure) working pressure, with monel screens and gasket seal on plug. Provide ball valve - no globe or needle valves. Smallest valve to be ½" full port IPS. All with ¾" hose connector.

B. Strainer screens shall have an open area equal to at least twice the cross-sectional area of the pipe in which they are installed (based on IPS) and may be either woven wire or perforated type in accordance with the following:

1. All Services: .045-inch diameter perf. or 16 square mesh.

C. Manufacturers: Armstrong Machine Works, Bailey Meters, Hoffman Specialty ITT; Fluid Handling Division, Watts Regulator Company, or equal.

2.09 VALVES

A. Provide valves as shown and other valves necessary to segregate branches or units. Furnish discs suitable for service intended. Furnish a brass tag with unique identification of service controlled for each valve. Properly pack and lubricate valves. No solder valves allowed. Provide flanged valves in welded pipe.

1. All fixtures and equipment branch lines to have shut-off valves at branch connection.
2. All Shut-off Valves will be IPS “or 3 piece body” valves. Three-piece valves may be soldered.
3. All angle stops will be IPS at wall, loose key. Threaded brass nipple shall be installed upstream of angle stop.
4. Shut off valves on heating and chilled water to be ball valves thru 2" and butterfly 2-½" and up. All valves are to be brazed, threaded or flanged. No solder.
5. Valves installed in insulated piping lines shall have valve handle extensions to clear the insulation. On insulation, affix label for valve location with directional arrow.
6. Shut-off valves shall be provided locally, upstream and downstream of all insulating fittings (unions, nipples, flanges, etc.) so that repairs can be made easily on these fittings.
7. All building shut-off valves from Central Plant distribution system shall be Class 150 stainless steel flanged ball valves, Nibco or equal.
8. Manufacturers: Nibco or equal.

B. Valves shall be full size of pipe in accordance with the following schedule: shut-off valves size ⅜" to 2" shall be ball valves; size 2-½ and larger shall be butterfly.

C. Four-inch and larger gate, Globe or O S & Y valves located 10 feet or higher above floor shall be provided with chain operators.

D. Balancing Valves shall provide multi-turn, 360º adjustment with a micrometer type indicator located on valve hand wheel. Valve handwheel shall have hidden memory feature which will provide a means for locking the valve in position after the system ha been balanced.

1. Manufacturers: Armstrong, Victaulic, or equal.
2. Plug design valves are not acceptable.
3. 90 Degree turn adjustable valves are not acceptable.

E. Butterfly Valves: Nibco, Norriseal or equal, equal to Demco Series NE. Provide lug body on valves located adjacent to equipment. All valves shall have EPT seats with aluminum bronze disc and throttling handle with memory stop. Furnish flow performance curve for each valve. Provide gear operators, handles for shut-off service, and infinite position throttling handles with indicator plates for balancing service. No wafer valves. All valves on heating water system shall be water 250ºF or higher.

F. Manual Air Vent Valves: At all high points and all coils, furnish a manual air vent with SOV. Assembly shall consist of a ½" IPS ball valve and ½" gooseneck pipe of same material as piping.

G. Shut off valves located in ceilings, walls, and floors shall bee accessible through access doors or ceiling lift out tiles (finished ceiling). Valve handles shall be located within 24" of access door.

H. Check valves shall be ball check Conbraco or equal.

PART III - EXECUTION

3.01 INSTALLATION OF PIPING SPECIALTIES

A. Pipe Escutcheons: Install pipe escutcheons on each pipe penetration through floors, walls, partitions, and ceilings where penetration is exposed to view and on exterior of building. Secure escutcheon to pipe or insulation so escutcheon covers penetration hole and is flush with adjoining surface.

B. Sleeves: Secure sleeves to metal or wood forms in such a manner that they will not become displaced during pouring of concrete. Fill sleeves on deck with sand. After forms have been removed from concrete, the sleeves shall be removed from the openings.

C. Core drill properly sized holes in the concrete to replace metal sleeves that are crushed or knocked out of position during pouring of concrete.

D. Sleeve Seals: Install in accordance with the following:

1. Lead and Oakum: Replace existing lead and oakum seals with link seal or equal.
2. Mechanical Sleeve Seals: Loosely assemble rubber links around pipe with bolts and pressure plates located under each bolt head and nut. Push into sleeve opening and center. Tighten bolts until links have expanded to form watertight seal.

E. At completion of project, Contractor shall submit a valve listing for all valves installed on the project. All valves shall be tagged with 2" diameter brass tags noting valve number

and contents in the pipe. Valve listing shall note valve tab number, contents in the pipe and the areas (room numbers, etc.) that are impacted when valve is in the closed position. Separate lists shall be made for the plumbing and mechanical systems. Valve listing sheets shall be 8-½" x 11" installed in a frame with glass cover and suitable for hanging in an area selected by University's Representative.

3.02 INSTALLATION OF Y-TYPE STRAINERS

A. Install Y-type strainers full size of pipeline in accordance with manufacturer's installation instructions. Install pipe nipple and shutoff valve in strainer blow down connection, full size of connection, except for strainers 2" and smaller installed ahead of control valves feeding individual terminals. No smaller than ½" - use ball. Where indicated, provide drain line from shutoff valve to plumbing drain, full size of blow-down connection.

B. All strainers shall have ball valve blow down valves not less ½" in size with ¾" hose connector with cap and washer.

C. Locate Y-type strainers in supply line ahead of the following equipment and elsewhere as indicated if integral strainer is not included in equipment:

1. Backflow Assemblies
2. Pumps
3. Temperature control valves
4. Pressure-reducing valves
5. Temperature-or pressure-regulating valves
6. All coils Delta "P" valves

3.03 INSTALLATION OF VALVES

A. Install valves where required for proper operation of piping and equipment, including valves in branch lines where necessary to isolate sections of piping. Locate valves so as to be accessible and so that separate support can be provided when necessary. All branches from vertical risers to have SOV's.

B. Install valves with stems pointed up, in vertical position where possible, but in no case with stems pointed downward from horizontal plane. Do not install check valves designed for horizontal use in the vertical position.

C. Provide threaded union at each connection to equipment and downstream of each valve. Provide unions at both ends of valves when valves cannot be turned due to an obstruction. Contractor shall furnish to University extended tee style valve handles for in-ground valves and special application valves with removable handles.

D. After piping systems have been tested and put into service, but before final testing, adjusting, and balancing, inspect each valve for possible leaks. Adjust or replace packing to stop leaks; replace valve if leak persists.

E. Tag each valve and provide a complete listing of valve locations and functions.

3.04 INSTALLATION OF UNIONS AND FLANGES

A. Install threaded unions and flanges so that piping can be easily disconnected for removal of tanks, equipment, and valves. Provide a minimum of three unions at each three-way valve.

END OF SECTION

SECTION 152500
MECHANICAL INSULATION

PART I - GENERAL

1.01 WORK INCLUDED

A. Types of insulation specified in this section include the following:

1. Piping System Insulation:

a. Chilled Water

2. Equipment Insulation:

a. Chilling Equipment

1.02 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of mechanical insulation products of type, material and sizes specified. Products have been in satisfactory use in similar service for not less than three (3) years. Contractor shall supply needed documentation to support the manufacturer’s qualification.

B. Installer's Qualifications: Firm with at least five (5) years successful installation experience on projects with mechanical insulation's similar to that required for this project.

C. Install thermal insulation products on equipment in accordance with manufacturer's written instructions and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.

D. Flame/Smoke Ratings: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics, and adhesives) with flame-spread rating of 25 or less and smoke-developed index of 50 or less, as tested by ASTM E 84 (NFPA 255) method.

E. Building insulation shall comply with California Quality Standards for insulating material.

F. Insulation material shall be certified by the California Energy Commission.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data in accordance with requirements of Specification Section 01330. Submit manufacturer's technical product data and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, K-value, thickness, density, and furnished accessories for each mechanical system requiring insulation. Include complete description of installation methods with this submittal.

B. Product Data and Maintenance Instructions: Submit in accordance with Specification Sections 01780 and 15010 requirements.

PART II - PRODUCTS

2.01 PIPE INSULATION MATERIALS

A. Calcium Silicate:

1. Hydrous calcium silicate material recommended for temperatures up to 1200°F. Applied per manufacturers recommendations.
2. Cover insulation with aluminum jacket. Apply jacket to insulated surfaces per manufacturer's recommendation. Provide pre-molded insulation covering on fittings.
3. After test, insulate all fittings, valves, bonnets, strainers, etc. to a thickness equal to the adjacent piping insulation. For copper pipe trim insulation as required to suit copper line outside diameters.
4. Manufacturers: Calsilite Insulation Products, Pabco Super Caltemp, or equal

B. Fiberglass Insulation:

1. Fiberglass Heavy Density 25, Johns-Manville Microlok, with ASJ-SSL jacket, or equal, with factory-applied, fire- retardant jacket and self-sealing laps, applied per manufacturer's recommendations.
2. Insulate fittings with JM Uni-Fit, or equal, pre-molded insulated covering secured with Standard fasteners.
3. Install a segment of rigid insulation at each pipe hanger for pipe sizes 2-½" and larger.
4. Finish all cold fittings with mastic and Z-tape to provide a vapor seal.
5. Insulate Victaulic couplings with a 12" long segment of Fiberglass as specified for concealed piping.
6. Manufacturers: Johns-Manville Corporation, Owens-Corning Fiberglass Corporation, or equal.

2.02 CHILLED WATER

A. Insulate exposed and concealed chilled water supply and return piping with 4 lb. nominal density fiberglass insulation.

B. Minimum Insulation Thickness:

1. Piping 1" and smaller: 1".
2. Piping 1-¼" and larger: 1-½".

C. Valves and Fittings

1. Insulate all valves, unions, Victaulic couplings, and other components in chilled water systems with pre-molded removable (replaceable) insulated covers.
2. Valves installed in insulated piping lines shall have valve handle extensions to clear the insulation. Affix label for valve location and directional flow.

D. Insulation Jacket

1. Cover all insulation that may be exposed to water, i.e. exterior piping, mechanical room, etc. with 20 mil thick fire-retardant PVC jacket. Apply jacket to insulated surfaces and seal with PVC solvent-type joints. Provide pre-molded insulation covering on fittings. Piping shall be sealed vapor tight to provide a continuous moisture-proof seal.

2.03 CHILLING EQUIPMENT

A. Insulate water-chilling equipment, including chilled water pump bodies, air separators, chillers, expansion tanks, etc., operating at reduced surface temperatures and which do not have factory-applied, low-temperature insulation.

B. Insulation shall be 3” thick, 3-lb. density fiberglass board.

C. Apply a 1-½” galvanized hexagonal mesh netting, stretched tight and securely fastened to the insulation, and cover with two coats of hard finish insulating cement to a total minimum thickness of ½”. Leave the first coat with a rough surface and allow to dry before the second coat is applied. Trowel the second coat smooth, and finish with 8-ounce canvas jacket, tightly pasted on with lagging adhesive.

D. Provide a light coat of dilute adhesive followed by two heavy coats of Fosters 30-36, or equal, no known equal, at the rate of 60 square feet per gallon over the entire surface of the canvas jacket. After this sealant has dried, apply Foster 30-35, or equal, no known equal, vapor barrier coating at the rate of 50 square feet per gallon.

E. Manufacturers: CertainTeed Corporation, Johns-Manville Corporation, Owens-Corning Fiberglas Corporation, or equal.

PART III - EXECUTION

3.01 INSTALLATION OF PIPING INSULATION

A. Install insulation products in accordance with manufacturer's written instructions and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.

B. Install insulation on pipe systems subsequent to testing and acceptance of tests.

C. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single-cut piece to complete run. Do not use cut pieces or scraps abutting each other.

D. Clean and dry pipe surfaces prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.

E. The term "piping" used herein shall include pipe, valves, strainers, and fittings. Apply insulating cements to fittings, valves, and strainers, and trowel smooth to the thickness of adjacent covering. Covering on valves shall extend up to the bonnet. The covering cement shall be of the types herein specified.

F. Extend piping insulation without interruption through walls, floors, and similar piping penetrations, except where otherwise indicated.

G. Install pipe hangers on the outside of the insulation and not in contact with the pipe. Protect insulation as hereinbefore specified under Hangers and Supports.

H. Neatly taper raw ends of insulation and seal with canvas and sealant as noted for fittings.

I. jacket and two finish coats of undiluted adhesive to exterior. Covering shall be even and level without lumps.

3.02 INSTALLATION OF EQUIPMENT INSULATION

A. Install insulation materials with smooth and even surfaces and on clean and dry surfaces. Redo poorly fitted joints. Do not use mastic or joint sealer as filler for gapping joints and excessive voids resulting from poor workmanship.

B. Do not apply insulation to equipment, while hot.

C. Do not insulate ASME stamps, or manufacturer's nameplate. Provide neatly beveled edge at interruptions of insulation.

END OF SECTION

SECTION 155000
HYDRONIC SYSTEMS AND EQUIPMENT

PART I - GENERAL

1.01 WORK INCLUDED

A. Types of hydronic specialties specified in this section include the following:

1. Vent Valves

2. Hydronic Piping

3. Water Relief Valves

1.02 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of hydronic piping products of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years.

B. Codes and Standards:

1. ASME Compliance: Fabricate and install hydronic piping in accordance with ASME B31.9 "Building Services Piping."

2. CMC Compliance: Fabricate and install hydronic piping in accordance with IAPMO "Uniform Mechanical Code."

3. Welding materials and labor shall conform to ASME Code and applicable state labor regulations.

4. Welders shall be fully qualified and certified by a state approved welding bureau. Each welder shall identify his work with a marking stamped on each weld joint of pipe.

5. Copper brazing (including Medical Gas -Medical vacuum pipe and fittings:

a. Certified yearly by P.I.P.E. or agency that meets AMS B2.2-85 brazing procedures, American Welding Society Standards.

b. Show current brazing certificates upon request. Certification shall be copied and kept on file by Contractor for duration of the job and provided to University's Representative to be kept on file by University's Plant Operations and Maintenance Plumbing Supervisor.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of hydronic specialty.

B. Record Drawings: At project closeout, submit Record Drawings of installed hydronic piping and piping products in accordance with requirements of Division 1.

C. Maintenance Data: Submit maintenance data and parts lists for hydronic piping materials and products. Include this data, product data, Shop Drawings, and Record Drawings in maintenance manual in accordance with requirements of Division 1.

PART II - PRODUCTS

2.01 MATERIALS

A. Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, temperature ratings, and capacities as indicated. Provide materials and products complying with ASME B31.9 Code for Building Services Piping where applicable, base pressure rating on hydronic piping systems maximum design pressures or as specified. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match pipe materials used in hydronic piping systems.

2.02 BASIC PIPES AND PIPE FITTINGS

A. Provide pipes and pipe fittings complying with Division 15 Basic Mechanical Materials and Methods section "Pipes and Pipe Fittings," in accordance with the following listing:

1. Chilled Water Piping: 2” and smaller, Copper tube; Type L, hard-drawn temper: wrought-copper fittings. Solder joints 1 ¼” and smaller, brazed joints 1 ½ and larger. Connections to threaded equipment, valves, etc. shall be copper threaded or flanged fittings.

2. Chilled Water Piping over 2” , ASTM A53 or ASTM A120 black steel, Schedule 40, with standard-weight, full-radius, butt-welding fittings and 150-lb, forged-steel, weld-neck type flanges. Connections to threaded equipment, valves, etc. shall be made with 150-lb, cast-iron, threaded fittings. Slip-on flanges will be permitted where space is limited with prior approval of the University's Representative. All slip-on flanges shall be back-welded. Piping over 2” can also be brazed copper, type L.

3. Water and Drain Connections to Equipment or to Stubs by Plumbing Contractor: Schedule 40 steel pipe with 150-lb, malleable-iron fittings. Provide unions with 6” brass nipples if connections are to copper lines. Pipe and fittings shall be black or galvanized as required to match piping to which connected.

4. Cooling Coil Condensate Drain Piping: ASTM A120 or ASTM A53 galvanized steel, Schedule 40 with 125-lb, galvanized, cast-iron fittings or 150-lb, galvanized, malleable-iron fittings. At Contractor's option, piping same as for air vent discharge piping may be used. Provide plugged tees or crosses at all changes in direction. Plugs shall utilize the same material as the primary piping or shall be equipped with unions with 6” brass nipples.

5. Relief Valve Discharge and Vapor Vent Piping: Same as specified for cooling coil condensate drain piping, except that plugged fittings will not be required.

2.03 BASIC VALVES

A. Provide valves complying with Division 15, Section 15050 – Basic Mechanical Materials and Methods, in accordance with the following listing.

B. Balance Valves:

1. Shall be Armstrong, Tour Anderson, or equal in design. Valve shall provide multi-turn, 360º adjustment with a micrometer type indicator located on valve hand wheel. Valve handwheel shall have hidden memory feature which will provide a means for locking the valve in position after the system is balanced. Plug design valves are not acceptable. 90º turn adjustable valves are not acceptable.

C. Air Vent Valves:

1. Manual air vents: At all high points, reheat coils, the air vent assemblies shall consist of a ½" IPS ball valve and ½" gooseneck pipe of same material as piping. Air vent valves shall be easily accessible within arms-reach at ceiling access.

D. Isolation Valves:

1. Provide isolation valves on all Hydronic piping into and out of Mechanical Rooms.

2.04 WATER RELIEF VALVES

A. Provide water relief valves as indicated, of size and capacity as selected by installer for proper relieving capacity, in accordance with ASME Boiler and Pressure Vessel Code.

B. Combined Pressure-Temperature Relief Valves: Bronze body, test lever, thermostat, complying with ANSI Z21.22 listing requirements for temperature discharge capacity. Provide temperature relief at 210ºF and pressure relief at 125 psi.

C. Pressure Relief Valves: Watts Series 740, Hoffman, or equal, bronze body, test lever, ASME rated.

D. Manufacturers: Armtrol, Inc., Wilkins, or equal.

PART III - EXECUTION

3.01 INSPECTION

A. Examine areas and conditions under which hydronic piping systems and specialties are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION OF VALVES

A. Drain Valves: Install on each mechanical equipment item located to completely drain equipment for service or repair. Install at base of each riser, at base of each rise or drop

in piping system, and elsewhere as indicated or required to completely drain hydronic piping system.

1. Shall be ball valve with hose adapter and cap.

B. Check Valves: Install on discharge side of each pump and elsewhere as indicated.

3.03 EQUIPMENT CONNECTIONS

A. Connect hydronic piping system to mechanical equipment as indicated, and comply with equipment manufacturer's instructions where not otherwise indicated. Install shutoff valve and union on supply and return; drain valve on drain connection.

1. Shall be ball valve with hose adapter and cap.

3.04 INSTALLATION OF HYDRONIC SPECIALTIES

A. Vent Valves:

1. Manual air vents: At all high points, reheat coils, the air vent assemblies shall consist of a ½" IPS ball valve and ½" gooseneck pipe of same material as piping. Air vent valves shall be easily accessible within arms-reach at ceiling access.

2. Automatic Vent Valves: Install automatic vent valves at top of each hydronic riser and elsewhere as indicated. Install shutoff valve between riser and vent valve, pipe outlet to suitable plumbing drain or as indicated.

B. In-Line Air Separators: Connect inlet and outlet piping.

C. Diaphragm-Type Expansion Tanks: Install diaphragm-type expansion tanks on floor as indicated, in accordance with manufacturer's instructions. Vent and purge air from hydronic system; charge tank with proper air charge as recommended by manufacturer.

D. Chemical Feeders: Install in upright position with top of funnel not more than 48" above floor. Install globe valve in pump discharge line between recirculating lines. Pipe drain to nearest plumbing drain or as indicated.

E. Water Relief Valves: Pipe discharge to floor drain or floor sink. Comply with ASME Boiler and Pressure Vessel Code.

3.05 INSTALLATION OF CHEMICAL TREATMENT SYSTEM

A. Comply with manufacturer's instructions for installation of chemical treatment system, except as otherwise indicated.

B. Piping shall be initially cleaned, before start-up of any equipment, with a suitable cleaning agent introduced into the piping system as recommended by the manufacturer. This treatment shall be circulated for not less than six hours, followed by flushing until neutral. Temporary circulating pumps shall be furnished by Contractor. Project pumps shall not be used for this purpose. Condenser water shall not be circulated until chemicals are introduced into the piping system.

C. Provide test equipment to test conductivity by portable solids meter, range 9-2500 ppm; nitrite by drop test; pH in range of 5.5 to 8.5 by color comparator; alkalinity by titration.

D. Secure the services of a water treatment specialist who will perform the following work:

1. Supervise initial clean out of piping systems.

2. Supervise installation of chemical feed equipment to assure that all water treatment work is properly installed as specified.

3. Make water analysis and establish chemical and water balance to prevent corrosion and scale formation in the recirculating water.

4. Instruct the University's personnel in the use and control of the chemical treatments supplied.

5. After completion of work, submit recirculating water analysis and certification to University's Representative that all work has been performed in accordance with Drawings and specifications.

6. Provide a one-year's supply of the required chemicals to the University at the completion of the job.

3.06 FIELD QUALITY CONTROL

A. Test hydronic piping in accordance with testing requirements of Division 15, Section 15050 – Basic Mechanical Materials and Methods.

3.07 ADJUSTING AND CLEANING

A. Clean, flush, and inspect hydronic piping systems in accordance with requirements of Division 15, Section 15050 – Basic Mechanical Materials and Methods.

3.08 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 and trim installed as part of this work. Leave systems and equipment in satisfactory operating condition.

B. After all equipment has been installed complete, the piping systems shall be cleaned as follows:

1. Add a solution of alkaline cleaner to the manufacturers recommended dosage. Circulate the system for 24 hours. Standby pumps should operate 50% of the circulation time, while all other pumps should operate 100% of the time. After 24-hour circulation time the system shall be drained, filled and operated repeatedly until clean and free of dirt and debris. Water quality should be that of incoming make-up water quality, and clarity should be clear. All strainers at pumps, control valves, and wherever else they are installed in the system shall have mesh elements removed, cleaned and/or replaced repeatedly until system can operate continuously without any dirt buildup on strainer elements. For closed loops add a corrosion inhibitor per manufacturer’s recommendations and dosage to maintain a Nitrite level (NO2) of the following:

a. Chilled water loops: 200-400 ppm NO2

b. Heating hot water loops: 400-600 ppm NO2

3.09 OPERATION TEST

A. Test each piece of equipment to show that it will operate in accordance with indicated requirements.

3.10 CLEANING UP

A. Upon completion of Work remove materials, equipment, apparatus, tools, and the like, and leave premises clean, neat, and orderly.

END OF SECTION 15500

SECTION 157620
FAN COIL UNITS

PART I – GENERAL

1.01 WORK INCLUDED:

A. Fan coil units as indicated on the Drawings and as specified.

B. BACS interface according to other Division 15 Sections and the Drawings.

1.02 REQUIREMENTS OF THE FOLLOWING DIVISION 15 SECTIONS SHALL APPLY TO THIS SECTION.

A. Division 15, Section 150500 – BASIC MECHANICAL MATERIALS AND METHODS

1.03 QUALITY ASSURANCE

A. Fan Performance Ratings: Conform to AMCA 210 and bear the AMCA Certified Rating Seal.

B. Store in clean dry place and protector from weather and construction traffic. Handle carefully to avoid damage to components, enclosures and finish.

1.04 SUBMITTALS

A. Submit shop drawings and product data under provisions of Division 1.

B. Clearly define any exceptions to specifications and drawings.

C. Shop drawings shall indicate assembly, unit dimensions, weight loading, required clearances, construction details, and field connection details.

D. Product data shall indicate dimensions, weights, capacities, ratings, fan performance, motor electrical characteristics, and gages and finishes of materials.

E. Provide fan curves with specified operating point clearly plotted.

F. Submit sound power levels that are results of actual tests performed according to the AMCA 300-95 Standard. The sound data shall represent the actual mechanical design conditions and shall include the outlet and inlet sound power levels reported in the standard octave band frequency of 63Hz to 4000Hz. Sound ratings reported in terms of zones dBA units and sound pressure levels shall not be an acceptable substitution for the specified sound power levels.

G. Submit product data of filter media, filter performance data, filter assembly, and filter frames.

H. Submit electrical requirements for power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Section 016000 in factory-fabricated protective containers, with factory-installed shipping skids and lifting lugs.

B. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test- run under observation.

PART II – PRODUCTS

1.01 MATERIALS

A. Fan Coil Units (FCU) shall be type and size as indicated on the Drawings. Capacities shall be as indicated for the specified operating conditions.

1. Units to be of the single zone draw thru or blow thru horizontal configuration as indicated on the Drawings and Schedules. Units shall include fan sections, cooling coils and heating coils with matching sections, motors, drives, filter sections with filters, plenums, thermostats and other accessories as specified.

2. Motors

a. Motors shall be open 1750 RPM mounted on an adjustable base. Voltage shall be as specified.

b. Single-phase motors shall be of the sizes and voltages as specified with automatic overload and resilient mount.

c. Polyphase motors may be supplied as required and may be rigid base.

d. Permanent split-capacitor motor (MI-DD) are to be supplied as specified in performance schedules and will be supplied with solid state speed regulators.

3. All belt drives are to be V-belt type with cast iron sheaves. Fan coils 1200 CFM capacity and below can use three-speed direct drive fan motors.

4. Bearings shall be cast iron pillow-block-housed ball bearings, grease lubricated with relief plugs and lubricant fittings with oversized shafts, sized to operate at less than 75% of the first critical speed.

5. Casing shall be constructed of minimum 20 gauge steel with full top or bottom access available through removable aluminum panels. Side access will be available as required. Interior of unit shall be insulated with 1" fiberglass neoprene-coated NFPA-approved insulation secured with adhesive with exposed edges coated to resist erosion. Unit exterior shall be finished enamel.

6. Discharge and intake plenum sections shall be as indicated on the Drawings with

motorized dampers where required.

7. Filters shall be of the size, type and arrangement as shown on the Drawings. Filter areas as specified are a minimum.

8. Coil section shall include a bright galvanized drain pan with ¾" drain connections under cooling coils and extended downstream to catch condensate carryover. Coils shall be completely encased in cabinet with no coil headers past outside dimensions of casing.

9. The fan section shall include DWDI forward curved wheels as scheduled with solid shaft, taperlock bushings and cast iron ball bearings. External vibration isolators are to be installed by the Contractor for each fan coil unit. Refer to Section 15240 for details of vibration hangers.

10. The coil section shall include a galvanized steel drain pan with ¾" drain connection under cooling coils and extended downstream to catch condensate carry over. Coils shall be completely encased in cabinet with no coil headers past outside dimension of casing. Coils shall have copper headers and shall be ARI certified. Coil areas scheduled are minimum.

11. Unit shall be furnished with a wall-mounted thermostat for field mounting by the manufacturer. The fan motor(s) shall be equipped with integral automatic temperature reset and motor current protection. The controller shall connect to the BACS for control and monitoring.

12. Combination motor starters shall be provided by this section where shown on the drawings and shall be specified according to the applicable section in Division 16.

13. VFDs shall be provided by this section where shown on the drawings and shall be specified according to the applicable section in Division 15.

14. Manufacturers: Trane, York, Carrier, or equal.

PART III – EXECUTION

1.01 EXAMINATION

A. Verify that surfaces are ready to receive work and opening dimensions are as instructed by the manufacturer.

B. Verify that required utilities are available, in proper location, and ready for use.

C. Beginning of installation means installer accepts existing surfaces.

1.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Flexible duct connection shall be used at the inlet and outlet duct connections. The flexible duct connections shall be made from coated fabric. The clear space between connected parts shall be a minimum of 2” and the connection shall have 1” minimum

slack material.

1.03 CLEANING

A. After construction is completed, including painting, clean exposed surfaces of units. Vacuum clean coils and inside of cabinets.

B. Touch-up marred or scratched surfaces of factory-finished cabinets, using finish materials furnished by manufacturer.

C. Install new filters.

END OF SECTION 15762

SECTION 158900
DUCTWORK

PART I - GENERAL

1.01 WORK INCLUDED

A. Types of ductwork required for this project include the following:

1. Sheet Metal Ductwork

2. Flexible Ductwork

3. Air Plenums

B. Construct all ductwork located between air handling unit and variable air volume boxes for 4” w.g. pressure class per SMACNA requirements and as listed herein.

C. Construct all other ductwork for 2” w.g. pressure class, except as noted, per SMACNA requirements.

1.02 QUALITY ASSURANCE

A. Installer: A firm with at least three years of successful installation experience on projects similar to that required for this work.

1. For work on fiberglass ductwork provide statement from manufacturer indicating that the manufacturer accepts this fabricator to be a qualified fabricator.

2. No fiberglass ductwork; no fiberglass in air stream.

B. SMACNA Compliance: Comply with applicable portions of Sheet Metal and Air Conditioning Contractor's National Association (SMACNA) for all work in this section.

C. ASHRAE Standards: Comply with American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE) recommendations, latest edition, for all work in this section.

D. NFPA Compliance: Comply with ANSI/NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems," and ANSI/NFPA 90B, "Standard for the Installation of Warm Air Heating and Air Conditioning Systems."

E. Patch, repair or replace ductwork as required. All ductwork shall be made airtight with 1% maximum or less leakage of design flow. Repair or replace ducts and joints as required to the satisfaction of the University's Representative.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's specifications on manufactured products and factory-fabricated ductwork, used for work of this section.

B. Record Drawings: At project close-out, submit Record Drawings of installed ductwork, duct accessories, and outlets and inlets in accordance with requirements of Division 1.

PART II - MATERIALS

2.01 GENERAL

A. All standing seams and transverse joints in ALL sheet metal ductwork shall be covered with 4” wide strip of 6-ounce canvas and lagging adhesive to assure airtight joints. Pressure-sensitive tapes not acceptable.

B. No interior duct liner accepted.

2.02 TWO-INCH PRESSURE CLASS DUCTWORK MATERIALS

A. Sheet Metal Ductwork: Except as otherwise indicated, fabricate ductwork with commercial grade of galvanized steel.

B. External Duct Lining:

1. Provide external duct lining only:

2. Oversize duct to maintain low pressure.

C. Round supply ductwork shall be of the same materials, gauges, and construction as that indicated for 4” pressure class ductwork.

D. Ductwork Support Materials: Except as otherwise indicated, provide hot-dipped galvanized steel fasteners, anchors, rods, straps, trim, and angles for support of ductwork.

2.03 TWO-INCH PRESSURE CLASS FABRICATION

A. Shop fabricate ductwork in 4-, 8-, 10- or 12-foot lengths, unless otherwise indicated or required, to complete runs. Pre-assemble work in shop to greatest extent possible, so as to minimize field assembly of systems. Disassemble systems only to extent necessary for shipping and handling. Match-mark sections for reassembly and coordinated installation.

B. Shop fabricate ductwork of gauges and reinforcement complying with SMACNA HVAC Duct Construction Standards, latest edition.

C. Fabricate duct fittings to match adjoining ducts and to comply with duct requirements as applicable to fittings. Except as otherwise indicated, fabricate elbows with center-line radius equal to 1.5 times associated duct width and fabricate to include turning vanes in

elbows where shorter radius is necessary. Limit angular tapers to 30º for contracting tapers and 20º for expanding tapers.

D. Fabricate ductwork with accessories installed during fabrication to the greatest extent possible. Refer to Division 15, Section 15910 – Duct Accessories for accessory requirements.

E. Fabricate round supply connections at rectangular, plenum-type fittings using spin-in type fittings, complete with extractor and volume control damper.

1. Provide spiral-lock seam prefabricated duct, as specified for 4” pressure class. Longitudinal seam duct shall not be used.

2.04 FOUR-INCH PRESSURE CLASS

A. Sheet Metal: Except as otherwise indicated, fabricate ductwork with commercial grade of galvanized sheet steel.

2.05 FACTORY-FABRICATED, FOUR-INCH PRESSURE CLASS

A. Spiral lock seam prefabricated factory-build round and oval duct and fittings shall be used wherever possible. Shop-fabricated ducts shall be used only where rectangular shaped

ducts are shown on plans or where transitions and special fittings cannot be prefabricated by factory.

B. Round Ductwork: Construct of galvanized sheet steel complying with ANSI/ASTM A 527 by the following methods and in minimum gauges listed.

1.

DIAMETER	MINIMUM GAUGE	METHOD OF MANUFACTURE
3" to 14"	26	Spiral Lockseam
15" to 26"	24	Spiral Lockseam
27" to 36"	22	Spiral Lockseam
37" to 50"	20	Spiral Lockseam
51" to 60"	18	Spiral Lockseam
Over 60"	16	Longitudinal Seam

C. Provide locked seams for spiral duct; fusion-welded butt seam for longitudinal seam duct.

D. Fittings and Couplings: Construct of minimum gauges listed. Provide continuous welds along seams.

1.

DIAMETER	MINIMUM GAUGE
3" to 36"	20
38" to 50"	18
Over 50"	16

E. Flat-Oval Ductwork: Construct of galvanized sheet steel complying with ANSI/ASTM A 527, of spiral lockseam construction, in minimum gauges listed.

1.

MAXIMUM WIDTH	MINIMUM GAUGE
Under 25"	24
25" to 48"	22
49" to 70"	20
Over 70"	18

F. Fittings and Couplings: Construct of minimum gauges listed. Provide continuous weld along seams.

1.

MAXIMUM WIDTH	MINIMUM GAUGE
Under 37"	20
37" to 50"	18
Over 50"	16

G. Manufacturers:

1. MANUFACTURER	PRODUCT
United Sheet Metal Div., United Magill Corp. Semco Manufacturing Incorporated Air Systems Incorporated - Las Vegas Or equal	Uniseal

2.06 MISCELLANEOUS DUCTWORK MATERIALS

A. Provide miscellaneous materials and products of types and sizes indicated, and where not otherwise indicated, provide requirements as listed in the latest SMACNA manuals, including proper connection of ductwork and equipment.

B. Fittings: Unless otherwise shown on Drawings, following fittings shall be used: two-piece, die-stamped, 45º to 90º elbows for sizes up to 8”; five-piece, 90º elbows for sizes over 8”; conical tees; and conical laterals. All reducers shall be placed after a tap has been made on the duct main. Reducers shall be long-taper style.

C. Duct Sealant: Non-hardening, non-migrating mastic or liquid elastic sealant as compounded and recommended by manufacturer specifically for sealing joints and seams in ductwork.

D. Duct Joints: Joint and seal prefabricated, factory-built ducts, fittings, and couplings in strict accordance with duct manufacturer's instructions. Install duct sealers, pop rivets or sheet metal screws and canvas and apply adhesive sealant, Foster SEALFAST, Hardcast Flex-Grip, Childers Chil-Perm or equal, on each joint. Duct sealer shall be fire retardant. Sheet metal screw for joints shall be minimum #10 size galvanized.

E. Duct Access: Provide access panel sections in prefabricated, factory-built ducts for access to fire dampers, control equipment, etc. as specified in Duct Accessories Section. Access panel size shall be duct diameter wide by duct diameter high for all ducts under 24”. Ducts over 24” in diameter shall have 24” x 18” access panels. Minimum size access panels shall be 6” x 6”.

2.07 FLEXIBLE DUCTS

A. Flexible ducts may be used in concealed areas only.

B. Factory insulate all flexible ducts with 1” thick, one- pound density fiberglass insulation and wrap with factory-installed vapor barrier jacket. Ducts shall be UL approved and tested and meet Class 1 requirements of NFPA 90A. Make elbows to maintain R/W-1.5.

C. Flexible ducts from rigid runouts to registers shall be Thermaflex M-KE, or equal, with maximum length of seven (7) feet. Flexible duct shall have no bends greater than 45º.

D. Flexible ducts shall consist of an exterior reinforced laminated vapor barrier, 1-½” thick fiberglass insulation (K= .25 @ 75ºF), encapsulated spring steel wire Helix and impervious,

smooth, non-perforated interior vinyl liner. Individual lengths of flexible ducts shall contain factory-fabricated steel connection collars.

1. Make connections to rigid duct and units with draw band and sealer, and then duct tape over outside of sheath.

2. Minimum bend radius shall be twice the duct diameter.

3. Insulated flexible duct shall be attached to collar with a worm drive draw band rated for 175 pounds and inserted a minimum of 1” on to collar. Securely attach insulation and vapor barrier to the collar using a second worm drive draw band rated at 175 pounds. The vapor barrier shall be drawn over the insulation and fastened by the draw band such that no raw insulation is exposed.

2.08 AIR PLENUMS

A. Construct air plenums designated on the Drawings of factory-fabricated panels or by Contractor-fabrication. In either case, provide all plenum enclosures in this work.

B. Factory-fabricated panels shall be 4” thick. Industrial Acoustics, United Sheet Metal, or equal. Panels shall be constructed of 20-gauge (min.) galvanized steel solid panels. Entire plenum shall be sealed and caulked airtight in accordance with manufacturer's instructions. Framing members manufactured by panel manufacturer shall be used throughout and connected to base with preset studs with sheet metal screws through framing members as recommended by manufacturer. Plenum shall provide structural rigidity to a minimum of 4” VC pressure differential, either positive or negative.

C. Fabricate Contractor fabricated panels as recommended by SMACNA Duct Construction Standards for 4” pressure differential.

PART III - EXECUTION

3.01 INSTALLATION OF DUCTWORK

A. Assemble and install ductwork in accordance with recognized industry practices which will achieve air tight (leakage class 12 for 2” pressure class and leakage class 3 for 4” pressure class) and noiseless (no objectionable noise) systems capable of performing each indicated service. Install each run with minimum of joints. Align ductwork accurately at connections within ⅛” misalignment tolerance and with internal surfaces smooth. Support

ducts rigidly with suitable ties, braces, hangers, and anchors of type which will hold ducts true to shape and to prevent buckling.

B. Seal ductwork after installation to seal class required and method prescribed in SMACNA "HVAC Leakage Test Manual," latest edition.

C. Install concrete inserts for support of ductwork in coordination with formwork as required to avoid delays in work.

D. Where ducts pass through interior partitions and exterior walls, conceal space between construction opening and duct or duct-plus- insulation with sheet metal flanges of same gauge as duct. Overlap opening on four sides by at least 1-½”.

E. Support ductwork in manner complying with SMACNA "HVAC Duct Construction Standards," latest edition, hangers and supports sections. Where special hanging of ductwork is detailed or shown on Drawings, Drawings shall be followed. Angles shall be attached to overhead construction in a manner so as to allow a minimum of 2” of movement in all directions with no bending or sagging of the angle.

F. Balancing dampers shall be installed in all branch ducts and elsewhere as indicated on the drawings.

G. Use radius elbows in rectangular ducts unless otherwise indicated. Square turn in rectangular ductwork at following locations: immediately upstream from supply air outlets. When required to facilitate installation. Do not install one square turn immediately after another.

H. All duct work on the high-pressure side of any seam 4" of water or higher shall use government clip or clip and flange with canvas and apply adhesive sealant on each connection.

I. Medium pressure ductwork (from fan discharge to CAV inlet); Extreme care shall be used in the fabrication and installation of the medium pressure ductwork to insure that it will be airtight. All ductwork shall be tested for leaks in sections as soon as possible and before any insulating.

J. Medium pressure duct: cap section ends and pressurize to 1-½ times fan static pressure, minimum 4” WC to 10 minutes.

K. All duct except medium pressure duct: Cap section ends and pressurize to 2" W.C. for 10 minutes.

L. Do not use flexible duct to connect to any air distribution device or terminal unit (with the exception of registers). Use flex connections where required by code or design for terminal units.

M. Provide access doors at each change in direction requiring turning vanes, at bottom of risers, and every 50’ in horizontal runs. Provide access doors in inaccessible ceilings and walls to gain access to all dampers, terminal units, coils, filters, valves, air vents, control

devices, traps, cleanouts and other similar devices requiring periodic observation adjustment, service or replacement.

N. Exact location of each access door shall be determined prior to installation and such information shall be submitted to University's Representative for review an approval. Ceiling access doors shall be no less than 24" x 24" and wall access doors shall be sized to suit equipment, but not less than 12" x 12".

3.02 TESTING FOUR-INCH PRESSURE CLASS DUCTWORK AND PLENUMS

A. Contractor to test all pressure ductwork and plenums for leaks using a portable high-pressure blower and necessary instrument. Extreme care shall be used in fabrication and installation of ductwork to ensure that it will be airtight. All ductwork shall be tested for leaks in sections as work progresses and as directed by University's Representative. Section to be tested shall have all open ends sealed off and shall then be tested using the following method:

1. Orifice Flow Test: Equipment required for this testing comprises a high-pressure blower, orifice test pipe assembly, and manometer with necessary valves and tubing. All testing shall be in conformance with SMACNA "HVAC Air Duct Leakage Test Manual," latest edition. Ductwork section being tested shall be held under a constant pressure of 4” of water with blower while any leakage flow through orifice is measured on manometer. Manometer readings shall be converted to CFM from a calibrated test curve. Leakage shall not exceed one percent of design air flow with a maximum allowable of 500 CFM. Complete information and data on equipment to be used must be submitted to University's Representative for approval before any tests are made.

B. Testing of any completed section of ductwork must be made before installation of finished ceiling, if any, or before ductwork is furred in inaccessible spaces and must be witnessed by University's Representative. Any leaks found must be properly repaired or joints remade, and section re-tested until tight. Leaks which cause any objectionable noise must be repaired, regardless of amount of leakage.

C. Upon completion of testing, the Contractor shall complete the test report forms provided by SMACNA "HVAC Air Duct Leakage Test Manual." These forms shall be made in triplicate and forwarded to the University's Representative for review.

3.03 CLEANING AND PROTECTION

A. Clean ductwork internally, unit by unit as it is installed, of dust and debris. Clean external surfaces of foreign substances which might cause corrosive deterioration of metal or where ductwork is to be painted.

B. Temporary Closure: At ends of ducts which are not connected to equipment or air distribution devices at time of ductwork installation, provide temporary closure of

polyethylene film or other covering which will prevent entrance of dust and debris until time connections are to be completed.

3.04 OPERATION TEST

A. Test each piece of equipment to show that it will operate in accordance with indicated requirements.

3.05 CLEANING UP

A. Upon completion of Work remove materials, equipment, apparatus, and tools, and leave premises clean, neat, and orderly.

B. Ductwork: Examine air-handling systems and clean any obstruction and debris. With dampers wide open and closed, run fan systems and check for air leaks.

C. All distribution equipment shall not be operated until the building is cleaned.

END OF SECTION 15890

SECTION 159100
DUCT ACCESSORIES

PART I - GENERAL

1.01 WORK INCLUDED

A. Types of ductwork accessories required for this project include the following:

1. Turning Vanes
2. Duct Hardware
3. Duct Access Doors
4. Flexible Connections
5. Dampers
6. Air Outlets and Inlets

1.02 QUALITY ASSURANCE

A. SMACNA Compliance: Comply with applicable portions of Sheet Metal and Air Conditioning Contractor's National Association (SMACNA) HVAC Duct Construction Standards (Metal and Flexible), latest edition, for all work in this section.

B. ASHRAE Standards: Comply with American Society of Heating, Refrigerating, and Air Conditioning Engineers, Inc. (ASHRAE) recommendations, latest edition, for all work in this section.

C. NFPA Compliance: Comply with ANSI/NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems," and ANSI/NFPA 90B, "Standard for the Installation of Warm Air Heating and Air Conditioning Systems."

D. UL Compliance: Construct, test, install and label fire dampers, smoke dampers, combination fire smoke dampers, and fire doors, in accordance with Underwriters Laboratories (UL) Standard 555 and 555S, "Fire Dampers and Ceiling Dampers," latest edition.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data in accordance with requirements of Division 1. Submit manufacturer's product data for each type of ductwork

accessory, including dimensions, capacities, and materials of construction, and installation instructions.

B. Equipment Data and Operation and Maintenance Instructions: Submit in accordance with Specification Sections 150100 requirements.

PART II - PRODUCTS

2.01 TURNING VANES

A. Fabricated Turning Vanes: Provide fabricated turning vanes and vane runners, constructed in accordance with SMACNA "HVAC Duct Construction Standards," latest edition. Vanes to be high efficiency profile of minimum 26 gauge hot-dipped galvanized steel. Side rails minimum 24 gauge hot-dipped galvanized steel.

B. Manufacturers: Aero Dyne HEP, Duro-Dyne Corporation, or equal.

2.02 DUCT HARDWARE

A. Provide duct hardware manufactured by one manufacturer for all items on project for the following:

1. Test Holes: Provide in ductwork at fan inlet and outlet and elsewhere as required for duct test holes consisting of slot and cover for instrument tests.

2. Quadrant Locks: Provide for each damper quadrant lock device on one end of shaft and end-bearing plate on other end for damper lengths over 12”. Provide extended quadrant locks and extended bearing plates for externally insulated ductwork.

B. Manufacturers: Ventfabrics, Inc., Young Regulator Company, or equal.

2.03 DUCT ACCESS DOORS

A. Provide airtight access doors in ducts and plenums for cleaning and repairs for volume and fire dampers for control devices within such ductwork and where shown on the Drawings.

B. Access doors into 2” pressure class ductwork shall be made of No. 24 gauge galvanized steel minimum, reinforced with angle iron stiffeners. Doors shall be hinged and provided with latches and gasket around entire edge to provide an airtight fit. Reinforce openings for doors with structural steel.

C. Access doors into ductwork greater than 2” pressure class shall be made of No. 22 gauge galvanized steel, removable double skin. Doors 16” and under to have two (2) locks. Doors over 16” to have four (4) locks.

D. Exact location of each access door shall be determined prior to installation and such information shall be submitted to University's Representative for review and approval.

E. Provide access doors at each change in direction requiring turning vanes, at bottom of risers, and every 50’ in horizontal runs.

F. Manufacturers: Ruskin, Ductmate, Nailor or equal.

G. Coordinate ceiling and wall access door locations with Architectural. Access doors shall be sized to suit equipment. Access doors in inaccessible ceilings and walls are required to gain access to all dampers, terminal units, coils, filters, valves, air vents, control devices, traps, cleanouts and other similar devices requiring periodic observation adjustment, service or replacement.

2.04 FLEXIBLE CONNECTIONS

A. Furnish and install flexible connections at following locations:

1. Exhaust

2. Duct connection of return fan

3. Duct connection of exhaust fan

4. Elsewhere as shown on Drawings

B. Flexible connections shall be preassembled flexible connectors constructed of coated glass fabric applied in accordance with manufacturer's recommendations. Width of flexible connections shall be sufficient to allow minimum of 2” of free space between two metal collars to be connected. Install sheet metal band completely around duct or fan outlet, at end of flexible connection. Fasten with metal screws through band and coated glass fabric. Space screws approximately 3” apart. Coated glass fabric shall be Ventfabrics Ventglas with neoprene coating for use inside building, or equal, and Ventlon with hypalon coating, or equal, when exposed to weather.

C. Manufacturers: Ventfabrics, Inc., Duro-Dyne Corporation, or equal.

2.05 DAMPERS

A. Manual Dampers: Provide dampers of single-blade type or multi-blade type constructed in accordance with SMACNA, "HVAC Duct Construction Standards," latest edition. Damper blades shall not exceed 6” in width, except that 8” wide damper may be used in 8” wide ducts.

1. Where dampers are installed above non-accessible ceilings, and are not served by access doors, provide extension rods and concealed ceiling mounted damper regulators. Regulator shall be equal to Ventlok Model 666.

2. Balancing dampers shall be installed in all branch ducts and elsewhere as indicated on the drawings.

B. Control Dampers: Refer to Division 15 Section "Temperature Control Systems" for control dampers, not work of this section.

C. Backdraft Dampers: Provide dampers with parallel blades, constructed of 16-ga. aluminum; provide ½” diameter ball bearings, ½” diameter steel axles spaced on 9” centers. Construct frame of 2” by ½” by ⅛” steel channel for face areas 25 sq. ft. and

under; 4” by 1-¼” by 16-ga. channel for face areas over 25 sq. ft. Provide galvanized steel finish on frame with aluminum touch-up.

D. Submit complete installation instructions for all types of damper to be used on this project, as part of main submittal.

E. Manufacturers: Ruskin Manufacturing Company, American Warming and Ventilating, Inc., Arrow Louver and Damper Corporation, or equal.

2.06 AIR OUTLETS AND INLETS

A. Grilles, registers, and diffusers shall be selected and guaranteed to operate without objectionable noise or draft.

B. Furnish and install sponge rubber gaskets between grilles and grounds of finished surfaces. Wood grounds will be furnished by others. Metal grounds shall be furnished by this Contractor. Sidewall grilles and registers shall be provided with dull prime coat finish, unless noted otherwise. All supply diffusers, registers, and grilles located at ceiling shall have factory-applied, bone-white finish.

C. Paint visible ductwork behind grilles, registers, and diffusers dull black.

D. Outlet/Inlet

1. Ceiling Diffuser

a. Titus Model MCD (with OBD where indicated on schedule) and throw reducing vanes, or equal. Provide frame style 1 for gypboard ceiling. Provide full 24 X 24 ceiling plates at T-bar ceilings, with frame style 3 to suit T-bar style.

2. Supply Register

a. Titus Model 272 RL (Wall) airfoil blade (with OBD where indicated on schedule), or equal.

3. Continuous Linear

a. Titus Model MPI, or equal.

4. Supply/Return

a. Linear supply diffuser with Border Type 2A and Model MLR Linear Return with Border Type 9A, or equal. Provide Supply/Return mitered end caps,

(linear) alignment strips, insulated supply plenums, slot width and number of slots as noted on Drawings.

5. Exhaust/Return

a. Titus Model 30RL Registers (with OBD where indicated on schedule), or equal, no known equal. Provide full 24 X 24 ceiling plates at T-Bar ceilings, with frame style to suit T-Bar style.

6. Extractor

a. Titus Model AG-45 with gear operator, or equal.

E. General: Except as otherwise indicated, provide manufacturer's standard ceiling air diffusers where shown of size, shape, capacity, and type indicated; constructed of materials and components as indicated and as required for complete installation. Provide diffusers with border styles that are compatible with adjacent ceiling systems and that are specifically manufactured to fit into ceiling module with accurate fit and adequate support. Refer to general construction Drawings and specifications for types of ceiling systems, which will contain each type of ceiling air diffuser.

F. Manufacturers: Titus, Krueger, or equal.

2.07 VARIABLE VOLUME BOXES

A. Furnish and install single duct, variable volume terminals of the sizes and capacities noted on the Drawings.

B. The terminals shall have pressure independent digital controls and shall be reset for airflow between zero and maximum cataloged cfm. Airflow limiters will not be accepted.

C. NC levels to be less than or equal to scheduled levels. Furnish sound data for both casing radiated and discharge sound levels for second through seventh octave bands as tested in accordance with ADC standards.

D. Static pressure drop shall not exceed scheduled values.

E. Terminals must be certified under the ARI Standard 880-89 Certification Program and carry the ARI seal. If the contractor wishes to submit a terminal which is not certified with ARI, the terminal must be tested at an independent testing laboratory under conditions selected by the University’s Representative in full compliance with the testing methods defined by

ARI Standard 880-89. Tests shall be witnessed by the University's Representative with all costs and expenses borne by the contractor. Testing does not ensure acceptance.

F. The terminal shall contain a multi-point, center averaging, amplifying velocity sensor. The measuring ports must be parallel to the take-off from the sensor.

G. All pneumatic tubing shall be UL listed, fire retardant (FR) type and of type specified in Section 15960, BACS.

H. The digital controller shall be factory mounted in a metal panel attached to the side of each terminal box.

I. The terminal casing shall not be less than 22 gauge galvanized steel with Fibre-Free lining (Steri-Loc for OSHPD applications), no fiberglass internal lining. The casing shall be sealed to hold leakage to 1% at 1-½" w.g.

J. The damper shall be heavy gauge metal, with its shaft rotating in Delrin self-lubricating bearings. The shaft shall be marked on the end to indicate the damper blade position. The terminal shall be designed for field conversion from normally closed to normally open.

K. The damper shall have a built-in stop to prevent over stroking and shall seal against a closed-cell foam gasket, to limit close-off leakage to the maximum of 2% at 6" w.g.

L. Units to be equipped with integral attenuator and hot water coil where specified. Manufacturers: Titus, Krueger, or equal.

2.08 DUCTWORK IDENTIFICATION

A. Ductwork identification shall consist of stencil-painted identification on ductwork housing of the air handling systems; including arrows to show flow, systems numbers and generic name of service. Mark primary runs at housing and main branches, and mark access doors to indicate equipment in housing or duct. Mark ductwork at 20' intervals. Where concealed behind removable ceilings, markings may be plasticized tags in lieu of stencil-painted markers.

1. Provide bakelite tags at areas where valves (equipment) are concealed above ceiling or behind access doors. Tags to describe concealed valves (equipment) color code for identification for plumbing shall be blue/HVAC-yellow/Electrical-green/Fire-red.

PART III - EXECUTION

3.01 INSTALLATION OF DUCT ACCESSORIES

A. Install duct accessories in accordance with manufacturer's installation instructions with applicable portions of details of construction as shown in SMACNA standards and in accordance with recognized industry practices to ensure that products serve intended function.

B. Install turning vanes in square or rectangular 90º elbows in supply and exhaust air systems and elsewhere as indicated.

C. Install access doors to open against system air pressure, with latches operable from either side, except outside only where duct is too small for person to enter.

D. Coordinate with other work as necessary to interface installation of duct accessories properly with other work.

E. Field Quality Control: Operate installed duct accessories to demonstrate compliance with requirements. Test for air leakage while system is operating. Repair or replace faulty accessories as required to obtain proper operation and leak proof performance.

3.02 INSTALLATION OF AIR OUTLETS AND INLETS

A. Install outlets and inlets in accordance with manufacturer's written instructions and in accordance with recognized industry practices to ensure that products serve intended functions.

B. Locate ceiling air diffusers, registers, and grilles as indicated on general construction "Reflected Ceiling Plans." Unless otherwise indicated, locate units in center of acoustical ceiling modules.

C. Examine areas and conditions under which outlets and inlets are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

D. Ceiling-mounted air terminals or services shall be positively attached to the ceiling suspension main runners or to cross runners with the same carrying capacity as the main runners.

1. Terminals or services weighing not more than 56 pounds shall have two No. 12 gauge hangers connected from the terminal or service to the structure above. These wires may be slack.

2. Terminals or services weighing more than 56 pounds shall be supported directly from the structure above by approved hangers.

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

A. Test each piece of equipment to show that it will operate in accordance with indicated requirements.

1. Any leaks found must be properly repaired, or joints remade and the section retested until tight. Any leaks which cause an objectionable noise in excess of 40 db must be repaired, regardless of the amount of the leakage. Any diffuser installation which causes an objectionable noise in excess of specified below must be corrected: Patient Rooms - 35 db; Office and Exam rooms - 40 db; Corridors and Waiting Rooms - 40 db.

2. The leakage shall not exceed 1% of the designed flow, with a maximum allowable in any case, of 50 CFM. No less than 50' of duct measured along the main shall be tested at one time. All branches shall be tested at same time as the main.

3.05 CLEANING UP

A. Upon completion of Work remove materials, equipment, apparatus, tools, and the like, and leave premises clean, neat, and orderly.

END OF SECTION 15910

SECTION 159600
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-16 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-15 sections for controls necessary for temperature control systems.

3. The BACS scope of work shall include all provisions for interface with the Automatic Lighting Controls System provided in Division 16. Refer to Division 16 for complete description of requirements for the Automatic Lighting Control System.

4. 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 Abode Acrobat complete with an interactive field linked Table of Contents (linked to the chapters and subsections within the report). Submit electronic copies on a CD (or CD's).

1.04 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 N2. 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)

3. One (1) Pentium 4, 3.6 GHz, Windows XP Professional based Personal Computer Operator Workstation, with one (1) Hewlett Packard color desk jet report printer (computer and printer manufacturer and configuration per University's requirements). This system shall include all necessary labor, materials, software, licenses, etc for a complete and operational system from this location including connections to all required data and voice lines.

4. Seamless lighting control system integration.

5. JCI integrator to Nellcor/Puritan Bennett medical gas system. The system shall be modular in nature, and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, standalone DDC panels, and operator devices.

C. System architectural design eliminates dependence upon any single device for alarm reporting and control execution. Each DDC panel shall operate independently by performing its own specified control, alarm management, operator I/O, and historical data collection. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.

D. Standalone DDC panels shall be able to access any date from, or send control commands and alarm reports directly to any other DDC panel or combination of panels on the network without dependence upon a central processing device. Standalone DDC panels shall also be able to send alarm reports to multiple operator workstations without dependence upon a central processing device.

2.04 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 form 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 of 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 date 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 date 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 of 2 hours, in one-minute intervals, shall be provided. Each standalone DDC panel shall have a dedicated buffer for trend date, 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 UCDMC data network wireless access points installed throughout the hospital by the UCDMC 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 159600

SECTION 159900
PLUMBING/HVAC FINAL TESTING, ADJUSTING AND BALANCING

PART I - GENERAL

1.01 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. Piping systems

2. Terminal units

3. Balance Valves for Plumbing systems

1.02 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.

1.03 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 Abode Acrobat complete with an interactive field linked Table of Contents (linked to the chapters and subsections within the report). Submit electronic copies on a CD (or 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.

1.04 JOB CONDITIONS

A. 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

2.01 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.

2.02 TEST INSTRUMENTS

A. 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

3.01 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. Pumps: Suction and discharge pressure.

3. Coils: Gallons per minute, fluid temperature, and air temperature at outlet and inlet.

4. All Rooms: Air temperature during test.

5. Other information required to establish completely balanced systems.

3.02 BALANCE REQUIREMENTS

A. 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.

B. After final air and hydronic balance of systems, make adjustments to obtain uniform temperatures as required by actual occupancy.

C. 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.

D. 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.

E. Adjust deflection of supply outlets to ensure proper and uniform air distribution throughout area served by such outlets.

F. Work with temperature Control Subcontractor in adjustment of automatic dampers, valves, thermostats, etc. required to maintain proper temperatures in all portions of building.

G. 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.

H. 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.

I. Return Air Shaft Test: Upon completion of construction of shafts to be used for return air, and after all pipe and duct penetrations are sealed, independent test and balance agency shall test shaft for leakage. Submit to Contractor a complete test report, and if required by results of this report, Contractor shall make repairs to shaft for the purpose of making it airtight. Upon completion of these repairs provide a retest and submit final report of results to University's Representative.

J. Seal shaft at openings, including openings into duct runs.

K. Provide test orifice and check an allowable loss of 250 C.F.M. at test pressure of 1-inch static pressure at each shaft.

L. Test equipment shall be capable of delivering minimum of 1500 C.F.M. and develop twice static pressure required in shaft.

M. 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.

N. Submit test equipment used to University's Representative for review before beginning work.

END OF SECTION 159900

SECTION 260500
ELECTRICAL WORK – GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 CONDITIONS

A. The Requirements of General Conditions and Special Conditions apply to Work of this Section as if fully repeated herein.

B. Drawings and specifications take precedence when they call for materials or construction methods of better quality or larger size than required by codes laws, rules, or regulations.

C. The Requirements of this Section apply to all Work of Division 26.

1.2 WORK INCLUDED

A. Provide a complete working installation with all material and equipment as shown and specified. The Contract Documents do not undertake to show or specify every item to be provided. When an item not shown or specified is necessary for proper operation of equipment shown or specified, provide the item, which will allow the system to function properly, at no increase in Contract Price.

B. Make electrical connections for equipment furnished as part of Work of other Sections.

C. Perform necessary equipment seismic anchorage in compliance with the California Building Code Title 24.

D. 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.

E. 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.

1.3 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies:

1. As specified in Division 1 - General Requirements.
2. Nothing in the Contract Documents shall be construed to permit Work not conforming to applicable laws, ordinances, rules, or regulations.
3. When the Contract Documents exceed requirements of applicable laws, ordinances, rules or regulations, Contract Documents shall take precedence.
4. It is not the intent of the Contract Documents to repeat requirements of Codes except where necessary for completeness or clarity.
5. All installed or connected equipment shall be labeled or certified for its use by a nationally recognized testing laboratory. Where equipment is not furnished with a factory installed

label or certification, it shall be the responsibility of the contractor to obtain and pay for the necessary tests and approvals.

1.4 SUBMITTALS

A. General:

1. Submit Shop Drawings and supplemental data for all materials and equipment specified in all Sections of this Division, in accordance with the Requirements of Division 1, and as specified hereinafter.
2. Submittals shall have materials proposed for the project identified. Catalog cuts containing unidentified materials or superfluous information will not be accepted.
3. All submittals shall be reviewed by the Contractor and stamped with his approval prior to submitting to the Architect. Contractor shall indicate in writing any deviation in submittals from requirement of Contract Documents.
4. Forward all submittals to the Architect, together, at one (1) time. Individual or incomplete submittals will not be acceptable. Only one (1) request for substitution will be considered on each item of materials or equipment.
5. Wherever catalog numbers and specific brands or trade names, not preceded by the designation "equal to", or followed by the designations "or equal", "or accepted equal", or "or approved equal", are mentioned in these Specifications or Drawings, no substitutions will be accepted.
6. Identify each item by manufacturer, brand, trade name, number, size, rating, or whatever other data is necessary to properly identify and check materials and equipment. The words "as specified" will not be sufficient identification.
7. Identify each submittal item by reference to Specification Section paragraph in which the item is specified or Drawing and Detail number.
8. Organize submittals in binders, in the same sequence as they appear in Specification Sections, article or paragraphs.
9. Shop Drawings shall show physical arrangement, construction details, finishes, materials used in fabrication, provisions for conduit entrance, access requirements for installation and maintenance, physical size, electrical characteristics, foundation and support details, and weight. Reuse of the Contract Drawings as Shop Drawings will not be acceptable.
    a. Specifically show, by drawn detail or note, that equipment complies with each specified requirements of the Contract Documents.
    b. Drawings shall be to scale and dimensioned (except wiring diagrams need not be to scale) and may be prepared by a vendor but shall be submitted as instruments of Contractor, thoroughly checked, and stamped by Contractor before submission to Architect for review.
    c. Catalog cuts and published material may be included to supplement scale drawings.
10. Internal wiring diagrams of equipment shall show wiring as actually furnished for this project, with all optional items clearly identified as included or excluded. Clearly identify external wiring connections. Identify and obliterate superfluous material.
11. External system wiring diagrams shall show wiring as actually installed, connected, and identified for this project. Include identification of cables, cable conductors, terminals in terminal cabinets, and connections to the identified external wiring connection points on equipment. Prepare Drawings on twenty-four inches (24") by thirty-six inches (36") minimum sheets bearing title block of equipment manufacturer, manufacturer's local engineering distributor, or Contractor, prepared to accepted drafting standards, and bearing Contractor's approved stamp.
12. Acceptance of a substitute is not to be considered a release from the Specifications. Correct any deficiencies in an item, even though approved, at Contractor's expense.

13. Be responsible for installation of approved substitution. Make any changes required for installation of approved substituted equipment at no increase in Contract Sum.

B. Operating and Maintenance Instructions and Materials:

1. After final completion and testing operations, part of the Work of this Division shall be responsibility for instructing the Owner's authorized representatives in operation, adjustment, and maintenance of electrical plant. Submit three (3) copies of certificate, signed by Owner's representatives, attesting to their having been instructed.
2. Before Owner's personnel assume operation of systems, submit three (3) bound sets of Operating and Maintenance Instructions, Manuals, and Parts Lists on the electrical plant and its component parts, including all major equipment and that which requires or for which manufacturer recommends maintenance in a specified manner. Provide names, addresses and telephone numbers of source of supply for parts.

1.5 PROJECT RECORD DOCUMENTS

A. Upon completion of Work, furnish Architect with complete sets of reproducible plans upon which shall be shown all Work installed under Contract. Drawings shall include actual locations of outlets, conduit, and wire sizing as well as routing and revised panelboard schedules.

B. All symbols and designations used in preparing Record Drawings shall match those used in Contract Drawings.

C. Maintain an up to date set of electrical drawings during the course of construction.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Identify materials and equipment delivered to site to permit check against materials list and Shop Drawings.

B. Protect from loss or damage. Replace lost or damaged materials and equipment with new at no increase in Contract Sum.

1.7 PROJECT EXAMINATION AND CONDITIONS

A. Examine project; verify dimensions and locations against Drawings and become informed of all conditions under which Work is to be done before submitting proposals.

B. Information shown relative to services is based upon available records and data but shall be regarded as approximate only. Make deviations found necessary to conform with actual locations and conditions with no increase in Contract Sum. Verify locations and elevation of utilities prior to commencement of excavation for new underground installations.

C. Exercise extreme care in excavating near existing utilities to avoid any damage thereto; be responsible for any damage caused by such operations.

1.8 DRAWINGS AND COORDINATION WITH OTHER WORK

A. Drawings:

1. For purposes of clarity and legibility, Drawings are essentially diagrammatic to the extent that many offsets, bends, special fittings, and the exact locations of items are not shown, unless specifically dimensioned.

2. Exact routing of wiring and locations of outlets, panels, and other items, shall be governed by structural conditions, and materials and equipment already in place. Use data in the Contract Documents. In addition, the Architect reserves the right, at no increase in Contract Sum, to make any reasonable change in locations of exposed electrical items, to group them into orderly relationships and/or increase their utility. Verify the Architect's requirements in this regard prior to roughing-in.
3. Dimensions, locations of doors, partitions and similar physical features shall be taken from Architectural Drawings and verified at the site as part of the Work of this Division. Consult the Architectural Drawings for exact location of outlets to center with architectural features, panels, and similar items, at the approximate locations shown on the Electrical Drawings.
4. Drawings indicate, generally, routes of all branch circuits. All runs to panels are indicated as starting from nearest outlet, pointing to direction of panel. Continue all such circuits, conduits to panel as though routes were indicated in their entirety.

B. Coordination:

1. Work out all "tight" conditions involving Work of this Division and Work of other Divisions in advance of installation. Provide additional Work necessary to overcome "tight" conditions, at no increase in Contract Sum.
2. Differences of disputes concerning coordination, interference or extent of Work between Divisions shall be decided by General Contractor. His decision, if consistent with Contract Document requirements, shall be final.
3. Provide adequate working space around electrical equipment in compliance with all applicable codes.
4. Coordinate electrical interface of mechanical equipment with the Work of Division 22 & 23.
5. Provide templates, information, and instructions for Work of other Divisions to properly locate holes and openings to be cut or provided for Electrical Work.
6. Size all feeders (conduit and wiring), motor starters, overload protection and circuit breakers to suit horsepower of motors or wattages of equipment furnished as part of the Work of the various Sections of the Specifications. In no case shall feeders and branch circuits (conduit and wiring) and circuit breakers be of smaller capacities or sizes than those shown or specified.
7. Schedule of Work - Refer to Section on Work Sequence.
8. Make every effort to keep existing electrical circuits, including telephone, public address, fire alarm, power, and other electrical services, in operation. Where power outages are unavoidable, schedule such outages with the Owner to occur at such times as to cause the least disruption of normal facility functions.

C. Equipment Rough-In:

1. Rough-in locations shown on Electrical Drawings for equipment furnished by the Owner and for equipment furnished under other Divisions are approximate only. Obtain exact rough-in locations from the following sources:
    a. From Shop Drawings for Contractor-furnished and installed equipment.
    b. From the Architect for Owner-furnished, Contractor-installed equipment.
    c. From the Architect for existing equipment where such equipment is relocated as part of the Work of this Contract.
2. Verify electrical characteristics of equipment before starting rough-in.
3. Unless otherwise shown or specified, equipment which requires electrical connection shall be installed as part of the Work of the Division in which specified. Internal components shall be wired to a single point with wiring in raceway direct connection (hardwired) to building electrical system or internal wiring and connections with cord and plug for receptacle connection to building wiring.

4. Unless otherwise shown or specified, provide direct raceway and conductor connections from building wiring system to equipment terminals for direct connected equipment which is Contractor-furnished and Contractor-installed, Owner-furnished and Contractor-installed, and for existing equipment relocated by the Contractor.
5. Insert plug in receptacle for cord-connected equipment which is Contractor-furnished and Contractor-installed, Owner-furnished and Contractor-installed and for existing equipment relocated by the Contractor. Provide new cord and plug if required on Owner-furnished and Contractor-installed equipment.
6. Provide disconnect switches, flush type in finished spaces, where shown or required by Codes for direct-connected equipment.
7. Disconnect existing equipment from building electrical system, including internal wiring required for relocation and reconnection at new location.

1.9 GUARANTEE

A. Provide guarantee in accordance with and in form required under Division 1. Repair or replace as may be necessary any defective work, material, or part with no increase in Contract Sum including repair or replacement of other Work, furnishing, equipment or premises caused by such repair or replacement of defective work.

1. Where other guarantee periods or requirements are called for in other sections of the contract documents, they shall take precedence over the requirements of Division 1.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Identify materials and equipment by manufacturer's name and nameplate data. Remove unidentified materials and equipment from site.

B. Equipment specified by manufacturer's number shall include all accessories, controls, and other components, listed in catalog as standard with equipment. Furnish optional or additional accessories as specified. All materials shall be UL labeled and in accordance with NEMA Standards.

C. Where no specific make of material or equipment is mentioned, any high-quality product of a reputable manufacturer may be used, provided it conforms to requirements of system and meets with Architect's acceptance.

D. Conflicts between Plans and Specifications, exclusive of the General Conditions of the Contract, the most stringent and higher quality requirement shall govern.

E. If the Contract Documents are not complete as to any detail such as accessories or hardware, of a required construction system or with regard to manner of installing of parts, materials, or equipment, but there exists an accepted trade standard for good and workmanlike construction, such detail or accessories shall be deemed to have been implicitly required by the Contract Documents in accordance with such standard.

F. Equipment and material damaged during transportation, installation, or operation will be considered as totally damaged. Replace with new. Variance from this will be permitted only with written acceptance.

G. Provide an authorized representative to constantly supervise the Work of this Division and to check all materials prior to installation for conformance with the Contract Documents.

H. Do not use equipment exceeding dimensions indicated for equipment, or arrangements that reduce required clearances, or exceed specified maximum dimensions.

2.2 FLASH PROTECTION

A. Electrical equipment including switchboards, panelboards, disconnect switches, etc. which are likely to require examination, adjustment or servicing while energized shall be field marked to warn of potential electric arch flash hazards per CEC Article 110.16. Marking shall be a pre-printed label which references NFPA 70E.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Manufacturer's Directions: Follow manufacturer's directions where manufacturers of articles used furnish directions covering points not specified or shown.

B. Equipment: Accurately set and level, neatly place support and anchor properly.

C. Assemble all equipment which requires assembling including Contractor-supplied bussing, internal wire connections where required; connect all incoming conduit, cable, and wires properly; and adjust and make ready for service electrical equipment and material required by this Contract.

D. All Work shall be done in orderly, workmanlike manner in accordance with NECA Standard of Installation and present neat appearing installation when completed.

E. Provide concrete pads for floor mounted electrical equipment.

1. Install minimum 4” high concrete pads, and a minimum of 2” beyond the equipment dimensions or as indicated. Other pad dimensions shall be as required to accommodate the equipment installed.
2. Use 3,000 PSI concrete.
3. Reinforce with 6” x 6” 10GA wire mesh with short dowels into floor at 12” on center around perimeter.
4. Chamfer top edges ¾”.
5. Make all faces smooth.
6. Set anchor bolts for equipment.
7. Coordinate the size of all pads and the location of all structural embedment requirements for anchor bolts and any vibration isolators.

3.2 NORMAL CONTINGENCIES

A. Protection: In performance of Work, protect existing facility and protect Work of other Sections as well as Work of this Section from damage.

1. Existing conduits which are required to be extended, altered, or reconnected shall be accomplished as shown or as directed. Existence of any wires, conduits, or other facilities are shown in a general way only. Determine existence, location, and condition on site.
2. Where existing conduits which are shown to be revised or which will be essential to functioning of particular system are cut or exposed due to construction changes, new connections shall be made in most expeditious manner as directed or shown. Where wiring is involved, new wires shall be "pulled-in" between nearest available accessible reused

outlets. In all cases where new wires are required, shown, or specified to be installed in existing conduits, if same cannot be installed, new conduits shall be provided therefore as directed.

3. Existing switchboards, motor control centers, and panelboards which are required to be extended, altered, or modified under the Work of this Division shall be provided with new sections, bus extensions, and all necessary hardware for a complete and operating system.
4. Attention is called to the fact that all new conduit, wiring, and apparatus shown or specified shall be connected to existing systems so as to function as complete units.
5. All conduits, electrical apparatus, and similar items, in place and not shown or specified to be reused or which will not be essential to functioning of various systems when Work is completed, shall be removed. No existing material shall be reinstalled or reused, unless shown or specified. Concealed conduits which are not shown or specified to be reused and become exposed due to construction changes shall be removed to nearest available accessible reused outlets.

3.3 PERFORMANCE

A. Sleeves, Chases, and Concrete Inserts:

1. This Division shall provide, to cause no delay, all required sleeves, chases, concrete inserts, anchor bolts, and similar items before concrete is placed, and be responsible for correct location and installation of same.
2. Sleeves and chases are prohibited in structural members, except were shown or as otherwise approved in writing.

B. Cutting and Patching:

1. Do all cutting and patching, including structural reinforcing, necessary for the Work of this Division.
2. No reinforcing steel or pre-stressed tendons may be cut within concrete floors without prior approval. All new cores or drilled holes shall be a minimum of 1 ½" clear of existing reinforcing. Concrete slabs must be scanned to determine the location of all reinforcing steel prior to coring, anchorage, drilling, or any other modifications.
3. Do no cutting or patching without prior approval. Repair damage done by cutting and patching equal to original condition, in Architect's opinion.

C. Provide metal backing plates, anchor plates, and similar items that are required for anchorage for the Work of this Section; securely weld or bolt to metal framing. Wood blocking or backing will not be permitted in combination with metal framing.

3.4 TESTING AND ADJUSTING

A. Furnish all labor and test equipment required for the Work of this Division. Testing work is defined as that work necessary to establish that equipment has been properly assembled, connected, and checked to verify that intent and purpose of the drawings, specifications, manufacturer's instruction manuals, and directions of Architect have been accomplished in satisfactory manner.

B. Provide field tests to verify component compliance with Specifications, including but not limited to adjusting, calibrating, and setting circuit breakers, relays, timers, etc.

C. 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 Architect, performance of equipment or systems is not in accordance with Contract Document or submitted data, alter, or replace equipment at no increase in Contract Sum.

D. Do not allow or cause any Work installed hereunder to be covered up or enclosed before it has been inspected and accepted. 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 condition in which it was found at time of cutting, all at no increase in Contract Sum.

E. At completion of Work provide written certification that all Systems are functioning properly without defects.

3.5 CLEANING AND PAINTING

A. Properly prepare Work of this Division to be finish painted as part of the Work of Painting Section.

B. Refinish Work supplied with final finish as part of the Work of this Division if damaged as part of the Work of this Division to satisfaction of Architect.

C. Thoroughly clean interiors of switchboards and motor control centers. After other Work is accomplished, clean exposed conduit, panels (interiors and exteriors), fixtures, and equipment, and leave in condition satisfactory to Architect.

D. Clean out and remove from site all surplus materials and debris resulting from this Work, including surplus excavated materials.

END OF SECTION

SECTION 260519
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes building wire and SO cable with insulation rated 600 volts and less; and wiring connectors and connections.

B. Related Sections:
   1. Section 26 05 53 - Identification for Electrical Systems: Product requirements for wire identification.

1.2 REFERENCES

A. International Electrical Testing Association:
   1. ANSI/NETA ATS – 2017 Acceptance Testing Specifications for Electrical Power Equipment and Systems.

B. NECA (National Electrical Contractors Association) - Standard of Installation.

C. ANSI/NFPA 70 – National Electrical Code (NEC).

D. Part 3, Title 24, - California Electrical Code (CEC).

E. Underwriters Laboratories, Inc. (UL).
   1. UL-83, UL-44 – Thermoplastic-Insulated Wire and Cables.

1.3 SYSTEM DESCRIPTION

A. Product Requirements: Provide products as follows:
   1. Stranded conductor for feeders and branch circuits 10 AWG and smaller.
   2. Stranded conductors for control circuits.
   3. Conductor not smaller than 12 AWG for power and lighting circuits. The minimum size of emergency system conductors shall be 10 AWG.
   4. Conductor not smaller than 16 AWG for control circuits.
   5. 10 AWG conductors for 20 amperes, 120-volt branch circuit home runs longer than 75 feet.
   6. 10 AWG conductors for 20 amperes, 277-volt branch circuit home runs longer than 200 feet.
   7. Cables shall be jacketed 600 volts SO type.

B. Wiring Methods: Provide the following wiring methods:
   1. Concealed Dry Interior Locations: Use only building wire, Type THHN/THWN-2 or XHHW-2 insulation, in raceway.
   2. Exposed Dry Interior Locations: Use only building wire Type THHN/THWN-2 or XHHW-2 insulation, in raceway.
   3. Exterior Locations: Use only building wire Type THHN/THWN-2 or XHHW-2 insulation, in raceway.
   4. Underground Locations: Use only building wire Type THHN/THWN-2 or XHHW-2 insulation, in raceway.
   5. Cord Drops: Use 600 volt ‘SO’ cable was indicated on drawings.

1.4 SUBMITTALS

A. Product Data: Submit for building wire and each cable type.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of components and circuits.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

1.7 FIELD MEASUREMENTS

A. Verify field measurements are as indicated on Drawings.

1.8 COORDINATION

A. Where wire and cable destination are indicated and routing is not shown, determine routing and lengths required.

B. Determine required separation between wire, cable, and other work. Determine cable routing to avoid interference with other work.

C. Wire and cable routing indicated is approximate unless dimensioned.

PART 2 - PRODUCTS

2.1 BUILDING WIRE

A. Manufacturers:
   1. Diamond Wire & Cable Co.
   2. Essex Group Inc.
   3. General Cable Co.
   4. Approved equal.

B. Product Description: Single conductor 600 volt insulated wire.

C. Conductor: Copper.

2.2 ELECTRICAL INSULATING TAPE:

A. 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.

2.3 INSULATING RESIN:

A. Use two-part liquid epoxy resin with resin and catalyst in premeasured, sealed mixing pouch. Scotchcast 3570G or equivalent.

2.4 REDUCING ADAPTERS:

A. Burndy, Thomas, and Betts or approved equal.

2.5 WIRING CONNECTORS

A. Bolted pressure connectors: Cast bronze compression bolts designed for parallel taps, tees, crosses, or end-to-end connections.

B. Insulated spring wire connectors (No. 10 AWG and smaller): multi-part construction incorporating a steel spring enclosed with a color-coded outer thermoplastic shell.

C. Insulated spring wire wet/damp location spring wire connectors: multi-part construction incorporating a steel spring enclosed with a color-coded outer thermoplastic shell pre-filled with silicone base to protect against moisture and corrosion.

D. Splices, taps and connectors (No. 8 AWG and larger): Burndy, T & B, or equal Tin-plated copper high-compression type lugs for installation with hand or hydraulically operated crimping tools and dies. Provide 2-hole lugs for size #4/0 AWG and larger wire were terminated to bus bars.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify interior of building has been protected from weather.

B. Verify mechanical work likely to damage wire and cable has been completed.

C. Verify raceway installation is complete and supported.

3.2 PREPARATION

A. Completely and thoroughly swab raceway before installing wire.

3.3 EXISTING WORK

A. Remove exposed abandoned wire and cable, including abandoned wire and cable above accessible ceiling finishes. Patch surfaces where removed cables pass through building finishes.

B. Disconnect abandoned circuits and remove circuit wire and cable. Remove abandoned boxes when wire and cable servicing boxes is abandoned and removed. Install blank cover for abandoned boxes not removed.

C. Provide access to existing wiring connections remaining active and requiring access. Modify installation or install access panel.

D. Extend existing circuits using materials and methods as specified.

E. Clean and repair existing wire and cable remaining or wire and cable to be reinstalled.

3.4 INSTALLATION

A. Route wire and cable to meet Project conditions.

B. Neatly train and lace wiring inside boxes, equipment, and panelboards.

C. 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.

D. Do not splice conductors in pull boxes, panelboards, switchboards, switchgear, motor control centers or motor control enclosures.

E. Identify and color code wire and cable under provisions of Section 26 05 53. Identify each conductor with its circuit number or other designation indicated.

F. Special Techniques--Building Wire in Raceway:

1. Pull conductors into raceway at same time.
2. Install building wire 4 AWG and larger with pulling equipment.
3. A maximum of three branch circuits are to be installed on any one conduit on 3 phase 4 wire system.
4. Install a minimum of twelve inches of slack conductor at each outlet.

G. Special Techniques – SO Cable:

1. Cable connectors shall be steel case liquid tight sized for the cable diameter and shall use strain relief gland fitting to prevent tension on conductor terminals.

H. Special Techniques - Wiring Connections:

1. Clean conductor surfaces before installing lugs and connectors.
2. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
3. Tape uninsulated conductors and connectors with electrical tape equal to the 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
4. Install solderless tool applied pressure connectors and lugs for copper conductor splices and taps, 8 AWG and larger.
5. Install insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.
6. Splices in conductors installed below grades are not permitted, unless approved in writing by the University’s Representative.
7. Outdoors or below grade, use wire connectors or compression type with heat shrink style watertight splice covers. Use Scotchcast 3570G resin epoxy to waterproof connections.
8. Install waterproof wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller in outdoor or wet locations.
9. Where oversized cables are used to accommodate voltage drop, whether a single or parallel feeder, provide appropriate reducing adapter and conductors for termination.
10. Secure conductors to circuit breakers, lugs and ground/neutral bus terminations utilizing a torque screwdriver or wrench to the manufacturer’s specified torque values.

3.5 WIRE COLOR

A. General

1. Color code all conductors. Wire sizes #6 AWG and smaller shall have integral color-coded insulation. Wire sizes #4 AWG and larger may have black insulation but identified by color coded

tape at all junctions, splice, pull or termination points. Tape shall be applied ½ lap to at least 6 inches of conductor. Color code wires as follows:

Conductors	120/209 Volts	277/480 Volts
Phase A	Black	Brown
Phase B	Red	Violet
Phase C	Blue	Yellow
Neutral	White	White or Gray
Ground	Green	Green

B. Branch Circuits: Shared neutral conductors for multiple circuits are not permitted. Provide a separate neutral conductor for each phase conductor.

C. Neutral Conductors: White. When two or more neutrals are located in one conduit, individually identify each with proper circuit number.

D. Branch Circuit Conductors: Install three or four wire home runs with each phase uniquely color coded.

E. Feeder Circuit Conductors: Uniquely color code each phase.

3.6 CONTROL, COMMUNICATION AND SIGNAL CONDUCTORS

A. Install in separate raceway systems from electrical line voltage wiring.

3.7 FIELD QUALITY CONTROL

A. Provide visual and mechanical inspection in accordance with NETA ATS, 7.3.2.A.

B. Subject cables sized #2 AWG and larger, rated 600 volts AC to insulation resistance test per NETA ATS 7.3.2 B.2. Make tests and record insulation resistance with circuits isolated from source and load.

C. Do not megger any cables after connecting to any equipment, unless specifically directed to do so by Architect.

D. Provide written test results and a final report of electrical tests per NETA ATS 5.4 to Architect.

END OF SECTION

SECTION 260526
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Wire.
   2. Mechanical connectors.
   3. Exothermic connections.

1.2 REFERENCES

A. Institute of Electrical and Electronics Engineers:
   1. IEEE 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.
   2. IEEE 1100 - Recommended Practice for Powering and Grounding Electronic Equipment.

B. International Electrical Testing Association:
   1. ANSI/NETA ATS – 2017 Acceptance Testing Specifications for Electrical Power Equipment and Systems.

C. Part 3, Title 24, - California Electrical Code (CEC).

1.3 SYSTEM DESCRIPTION

A. Grounding systems use the following elements as grounding electrodes:
   1. Existing Metal underground water pipe.
   2. Metal building frame.

B. All panelboards, junction boxes, pull boxes, wireways, device boxes, and equipment enclosures shall be bonded to the separate green equipment grounding conductor.

1.4 SECONDARY GROUNDING SYSTEM

A. The grounding system shall be provided as shown and shall meet the requirements of CEC Article 250.

B. In addition to the major components shown and required by Article 250, the grounding system shall include all fittings, connectors, devices, and material necessary for a complete and useable system.

C. Bond the grounding system to existing building columns.

1.5 QUALITY ASSURANCE

A. Provide grounding materials conforming to requirements of NEC, IEEE 142, and UL labeled.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.

B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

C. Do not deliver items to project before time of installation. Limit shipment of bulk and multiple-use materials to quantities needed for immediate installation.

PART 2 - PRODUCTS

2.1 WIRE

A. Grounding Electrode Conductor: Copper conductor insulated if in conduit or above grade exposed, bare if direct buried.

B. Bonding Conductor: Stranded copper with dual rated THHN/THWN insulation, color identified green. Where continuous color-coded conductors are not commercially available, provide a minimum 4” long color band with green, non-aging, plastic tape in accordance with the CEC.

2.2 MECHANICAL CONNECTORS

A. Description: Bronze connectors, suitable for grounding and bonding applications, in configurations required for installation.

2.3 CONNECTIONS

A. Provide high pressure compression type or exothermic materials, accessories, and tools for preparing and making permanent field connections between grounding system components.
   1. Exothermic welds shall be used for cable to cable and cable and for cable to structural steel surfaces.
   2. Pressure indented copper cable terminal, one hole with one inch galvanized or cadmium plated steel machine bolts and beveled washer each side shall be used for cable-to-ground bar and cable-to-equipment connections.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify final backfill and compaction has been completed before driving rod electrodes.

3.2 PREPARATION

A. Remove paint, rust, mill oils and surface contaminants at connection points.

3.3 EXISTING WORK

A. Extend existing grounding system using materials and methods as specified.

3.4 GROUNDING ELECTRODE SYSTEM

A. Provide grounding electrode conductor as indicated on the Drawings or sized per CEC Article 250, whichever is greater.

B. Install grounding and bonding conductors concealed from view.

3.5 POWER SYSTEM GROUNDING

A. Provide, unless otherwise indicated, a main building power system ground bus mounted on the wall in new telecom rooms. Connect the following items using CEC sized copper grounding conductors to lugs on the main building ground bus:

1. Bonding conductor to building structural steel.

3.6 EQUIPMENT GROUNDING

A. Equipment Grounding Conductor: Provide a CEC sized insulated copper ground conductor in all 120VAC through 600 VAC feeder and branch circuit distribution conduits and cables.

B. Provide a separate grounding bus at panelboards, switchboards, motor control centers. Connect all metallic enclosed equipment so that with maximum fault current flowing, shall be maintained at not more than 35 volts above ground.

C. Conduit terminating in concentric, eccentric, or oversized knockouts at panelboards, cabinets, gutters, etc. shall have grounding bushings and bonding jumpers installed interconnecting all such conduits.

D. Provide bonding jumpers across expansion and deflection couplings in conduit runs, pipe connections to water meters, dielectric couplings in metallic cold water piping system.

E. Provide internal ground wire in flexible conduit connected at each end via grounding bushing.

F. Provide external ground wire wrapped around flexible conduit and terminate to connectors designed for the purpose.

G. Install continuous grounding using underground cold-water system and building steel as grounding electrode. Where water piping is not available, install artificial station ground by means of driven rods or buried electrodes.

H. Permanently ground entire light and power system in accordance with CEC, including service equipment, distribution panels, lighting panelboards, switch and starter enclosures, motor frames, grounding type receptacles, and other exposed non-current carrying metal parts of electrical equipment.

I. Accomplish grounding of electrical system by using insulated grounding conductor installed with feeders and branch circuit conductors in conduits. Size grounding conductors in accordance with CEC or as indicated on drawings.

J. Install from grounding bus of serving panel to ground bus of served panel, grounding screw of receptacles, lighting fixture housing, light switch outlet boxes or metal enclosures of service equipment.

K. Ground conduits as necessary by means of grounding bushings on terminations at panelboards and switchboards to grounding bus.

L. Permanently attach equipment and grounding conductors prior to energizing equipment.

3.7 SEPARATELY DERIVED ELECTRICAL SYSTEM GROUNDING

A. Ground each separately derived system per requirements in CEC Article 250 as a minimum, unless greater requirements are required elsewhere in the Contract Documents.

B. Transformers: Provide a dual rated four or six-barrel grounding lug with a 5/8"-11 threaded hole. Drill enclosure with 11/16" bit and attach lug to enclosure utilizing a torque bolt and a dragon tooth transition washer or equal. Connect the following when present:

1. Building steel.

3.8 FIELD QUALITY CONTROL

A. Provide visual and mechanical inspection in accordance with NETA ATS, 7.13.A.

END OF SECTION

SECTION 260529
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Conduit and cable tray supports.
   2. Formed steel channel.
   3. Spring steel clips.
   4. Sleeves.
   5. Mechanical sleeve seals.
   6. Firestopping relating to electrical work.
   7. Floor and wall mounted equipment base and support.

1.2 REFERENCES

A. ASTM International:
   1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
   2. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
   3. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
   4. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems.

B. Part 3, Title 24, - California Electrical Code (CEC).]

C. Underwriters Laboratories Inc.:
   1. UL 1479 - Fire Tests of Through-Penetration Firestops.
   2. UL - Fire Resistance Directory.

1.3 DEFINITIONS

A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.4 SYSTEM DESCRIPTION

A. Firestopping Materials: UL 1479, to achieve fire ratings in accordance with UL Design Numbers noted on Drawings.

1.5 PERFORMANCE REQUIREMENTS

A. Penetrations: Provide through-penetration firestop systems that are installed to resist the spread of fire, passage of smoke and other hot gases according to requirements indicated, to restore the original fire-resistance rating of assembly penetrated.
   1. Install complete through penetration firestop systems that have been tested and are listed by recognized testing agencies per ASTM E 814 or UL 1479 fire tests in a configuration that is representative of site conditions.

2. F-Rated Systems: Install through-penetration firestop systems with F-ratings indicated, as determined per ASTM E 814 or UL 1479, but not less than the fire resistance rating of the assembly being penetrated.
3. T-Rated Systems: Install through-penetration firestop systems with T-ratings indicated, as well as F-ratings, as determined per ASTM E 814 or UL 1479, where required by the Building Code.

B. Support systems shall be adequate for weight of equipment and raceways, including wiring which they carry.

1.6 SUBMITTALS

A. Product Data:
1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
2. Firestopping: Submit data on product characteristics, performance, and limitation criteria.

B. Design Data: Indicate load carrying capacity of hangers and supports.

C. Manufacturer's Installation Instructions:
1. Hangers and Supports: Submit special procedures and assembly of components.
2. Firestopping: Submit preparation and installation instructions.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

E. Engineering Judgements: For conditions not covered by UL or WH listed designs, submit judgements by licensed professional engineer suitable for presentation to authority having jurisdiction for acceptance as meeting code fire protection requirements.

1.7 SEISMIC DETAILS AND CALCULATIONS

A. Submit details and calculations for support and anchors that are not specifically detailed on the Drawings where required by California Building Standards Code, California Code of Regulations, Title 24. Pre-approved systems may be used as noted below only if the pre-approval is current and accepted by the local agency having jurisdiction.

1.8 QUALITY ASSURANCE

A. Through Penetration Firestopping of Fire Rated Assemblies: UL 1479 with 0.10-inch water gage minimum positive pressure differential to achieve fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
1. Wall Penetrations: Fire F-Ratings as indicated on Drawings, but not less than 1-hour.
2. Floor Penetrations: Fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
a. Floor Penetrations Within Wall Cavities: T-Rating is not required.

B. Through Penetration Firestopping of Non-Fire Rated Floor and Roof Assemblies: Materials to resist free passage of flame and products of combustion.
1. Noncombustible Penetrating Items: Noncombustible materials for penetrating items connecting maximum of three stories.
2. Penetrating Items: Materials approved by authorities having jurisdiction for penetrating items connecting maximum of two stories.

1.9 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years experience.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.

B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

1.11 ENVIRONMENTAL REQUIREMENTS

A. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees F.

B. Maintain this minimum temperature before, during, and for minimum 3 days after installation of firestopping materials.

PART 2 - PRODUCTS

2.1 CONDUIT SUPPORTS

A. Hanger Rods: Threaded high tensile strength galvanized carbon steel with free running threads.

B. Beam Clamps: Steel or Malleable Iron, with tapered hole in base and back to accept either bolt or hanger rod. Set screw: hardened steel.

C. Conduit clamps for trapeze hangers: Galvanized steel, notched to fit trapeze with single bolt to tighten.

D. Conduit clamps - general purpose: One-hole malleable iron for surface mounted conduits.

E. Cable Ties: High strength nylon temperature rated to 185 degrees F. Self locking.

2.2 FORMED STEEL CHANNEL

A. Product Description: 1 5/8 inches square Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

2.3 SPRING STEEL CLIPS

A. Spring steel conduit hanger to threaded rod.

2.4 SLEEVES

A. Sleeves for Through Non-fire Rated Floors: 18 gage thick galvanized steel.

B. Sleeves for Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.

C. Sleeves for Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed.

D. Fire-stopping Insulation: Glass fiber type, non-combustible.

2.5 MECHANICAL SLEEVE SEALS

A. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.6 FIRESTOPPING

A. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.

1. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.

2.7 FIRESTOPPING ACCESSORIES

A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.

B. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.

C. General:

1. Furnish UL listed products.
2. Select products with rating not less than rating of wall or floor being penetrated.

D. Non-Rated Surfaces:

1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where conduit is exposed.
2. For exterior wall openings below grade, furnish modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill annular space between conduit and cored opening or water-stop type wall sleeve.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify openings are ready to receive sleeves.

B. Verify openings are ready to receive firestopping.

3.2 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.

B. Remove incompatible materials affecting bond.

C. Install damming materials to arrest liquid material leakage.

D. Obtain permission from Architect/Engineer before using powder-actuated anchors.

E. Do not drill or cut structural members.

3.3 INSTALLATION - HANGERS AND SUPPORTS

A. Anchors and Fasteners:
   1. Concrete Structural Elements: Provide expansion anchors.
   2. Steel Structural Elements: Provide beam clamps.
   3. Concrete Surfaces: Provide expansion anchors.
   4. Hollow Masonry, Plaster, and Gypsum Board Partitions: Provide structural backing plate.
   5. Solid Masonry Walls: Provide expansion anchors.
   6. Sheet Metal: Provide sheet metal screws.
   7. Wood Elements: Provide wood screws.

B. Install conduit and raceway support and spacing in accordance with the California Electrical Code.

C. Install all support devices according to manufacturer's guidelines and recommendations.

D. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.

E. Do not drill through structural framing members.

F. 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.

G. Install multiple conduits runs on common hangers.

H. Supports:
   1. Fabricate supports from structural steel or formed steel channel. Install hexagon head bolts to present neat appearance with adequate strength and rigidity. Install spring lock washers under nuts.
   2. Install surface mounted cabinets and panelboards with minimum of four anchors.
   3. In wet and damp locations install steel channel supports to stand cabinets and panelboards 1 inch off wall.
   4. Support vertical conduit at every floor.
   5. Clip type hangers may be used in concealed areas on individual conduit runs.
   6. Group mounted, exposed, or concealed raceways shall be supported by trapeze hangers constructed of formed steel channels and treaded rods.

3.4 INSTALLATION - FIRESTOPPING

A. Install material at fire rated construction perimeters and openings containing penetrating

sleeves, piping, ductwork, conduit, and other items, requiring firestopping.

B. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating.

C. Fire Rated Surface:
   1. Seal opening at floor, wall, partition, ceiling, and roof as follows:
      a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
      b. Pack void with backing material.
      c. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.

D. Non-Rated Surfaces:
   1. Seal opening through non-fire rated wall, partition floor, ceiling, and roof opening as follows:
      a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
      b. Install type of firestopping material recommended by manufacturer.
   2. Install escutcheons where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
   3. Exterior wall openings below grade: Assemble rubber links of mechanical seal to size of conduit and tighten in place, in accordance with manufacturer's instructions.
   4. Interior partitions: Seal pipe penetrations at telecommunication rooms. Apply sealant to both sides of penetration to completely fill annular space between sleeve and conduit.

3.5 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

A. Provide housekeeping pads of concrete, minimum 4 inches thick and extending 6 inches beyond supported equipment.

B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.

C. Construct supports of formed steel channel. Brace and fasten with flanges bolted to structure.

3.6 INSTALLATION - SLEEVES

A. Exterior watertight entries: Seal with adjustable interlocking rubber links.

B. Conduit penetrations not required to be watertight: Sleeve and fill with silicon foam.

C. Set sleeves in position in forms. Provide reinforcing around sleeves.

D. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

E. Extend sleeves through floors 1 inch above finished floor level. Caulk sleeves.

F. Where conduit or raceway penetrates floor, ceiling, or wall, close off space between conduit or raceway and adjacent work with fire stopping insulation and caulk.

G. Install chrome plated steel escutcheons at finished surfaces where penetrations occur below finished ceilings.

3.7 FIELD QUALITY CONTROL

A. Inspect installed firestopping for compliance with specifications.

3.8 CLEANING

A. Clean adjacent surfaces of firestopping materials.

3.9 PROTECTION OF FINISHED WORK

A. Protect adjacent surfaces from damage by material installation.

END OF SECTION

SECTION 260533
RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes conduit and tubing, surface raceways, wireways, outlet boxes, pull and junction boxes.

B. Related Sections:

1. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
2. Section 26 05 29 - Hangers and Supports for Electrical Systems.
3. Section 26 05 53 - Identification for Electrical Systems.
4. Section 26 27 16 - Electrical Cabinets and Enclosures.
5. Section 26 27 26 - Wiring Devices.

1.2 REFERENCES

A. American National Standards Institute:

1. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
2. ANSI C80.3 - Specification for Electrical Metallic Tubing, Zinc Coated.

B. National Electrical Manufacturers Association:

1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
2. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
3. NEMA OS 1 - Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
4. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports.
5. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
6. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
7. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

C. Part 3, Title 24, - California Electrical Code (CEC).

1.3 SYSTEM DESCRIPTION

A. Raceway and boxes located as indicated on Drawings, and at other locations required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements. Raceway and boxes are shown in approximate locations unless dimensioned. Provide raceway to complete wiring system.

1.4 DESIGN REQUIREMENTS

A. Minimum Raceway Size:

1. 3/4 inch.
2. 1 inch outside foundation line.

1.5 SUBMITTALS

A. Product Data: Submit for the following:
   1. Metallic conduit.
   2. Electrical metallic tubing.
   3. Flexible metal conduit.
   4. Liquid tight flexible metal conduit.
   5. Nonmetallic conduit.
   6. Raceway fittings.
   7. Conduit bodies.
   8. Surface raceway.
   9. Wireway.
   10. Pull and junction boxes.

B. Manufacturer's Installation Instructions: Submit application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

C. Provide Seismic Shop Drawings from a structural engineer licensed in the state of California for any conduit support systems containing conduits 2.5” or larger in trade size or assemblies weighing over 10 lbs. per linear foot which are suspended further than 12” from the point attachment to the building structure to the top of the conduit or trapeze support systems.

1.6 CLOSEOUT SUBMITTALS

A. Project Record Documents:
   1. Record actual routing of conduits larger than 2 inches.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

1.8 COORDINATION

A. Coordinate mounting heights, orientation and locations of outlets mounted above counters, benches, and backsplashes.

B. Coordinate Work of this Division and Work of other Divisions in advance of installation. Provide additional Work to overcome tight conditions at no increase in Contract Sum.

C. Coordinate installation of outlet boxes for equipment specified in other divisions.

PART 2 - PRODUCTS

2.1 METAL CONDUIT

A. Rigid Steel Conduit: ANSI C80.1.

B. Intermediate Metal Conduit (IMC): Rigid steel.

C. Fittings: NEMA FB 1. Fittings shall be steel with threaded fittings. Use insulated metallic bushings with lug where ground connections are required. Use plastic bushing for non-bonding applications.

D. Conduit Bodies: Bodies connected to rigid steel or intermediate conduit shall be the cast iron. Provide matching gasketed stainless steel cover with at least two corrosion resistant screws. Die cast aluminum products are not permitted.

2.2 PVC COATED METAL CONDUIT

A. Product Description: NEMA RN 1; rigid steel conduit with external PVC coating, 40 mil thick.

B. Fittings and Conduit Bodies: NEMA FB 1; steel fittings with external PVC coating to match conduit.

2.3 FLEXIBLE METAL CONDUIT

A. Product Description: Interlocked steel construction.

B. Fittings: NEMA FB 1; Fittings shall be steel insulated throat type rated as suitable for system ground continuity.

2.4 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

A. Product Description: Interlocked steel construction with PVC jacket. Minimum size shall be ¾".

B. Fittings: NEMA FB 1; fittings shall be liquid tight with watertight connectors when installed in damp or wet locations.

C. Connectors for liquid tight flexible conduit shall be screw-in ground cone type.

2.5 ELECTRICAL METALLIC TUBING (EMT)

A. Product Description: ANSI C80.3; galvanized tubing.

B. Fittings: NEMA FB 1; steel compression concrete tight couplings and connectors. Fittings shall meet same requirements for finish and material as EMT conduit. Box connectors shall have nylon insulated throat. Set screw type couplings are not permitted.

C. Fittings shall be assembled with anti-corrosion, conductive anti-seize compound at joints made tight to exclude water.

D. Conduit Bodies: Bodies shall be the cast iron. Provide matching gasketed stainless steel cover with at least two corrosion resistant screws. Die cast aluminum products are not permitted.

2.6 NONMETALLIC CONDUIT

A. Product Description: NEMA TC 2; Schedule 40 or 80 PVC.

B. Fittings: NEMA TC 3.

C. Non-metallic conduit fittings shall be of the same material as the conduit furnished and be the product of the same manufacturer.

D. PVC 90-degree bends shall not be used. Wrapped rigid conduit will be used in its place. Double lap of Calpico 10 mil or approved equal.

2.7 WEATHERPROOF CABLE TERMINATERS

A. Product Description: Dust tight and liquid tight with sealing ring and insulated throat.

B. Bushing shall be OZ/Gedney type KR or equal.

2.8 EXPANSION AND DEFLECTION FITTINGS

A. OZ/Gedney type DX or equal.

2.9 SURFACE METAL RACEWAY

A. Manufacturers:
   1. The Wiremold Co. Series 2000, 3000 4000, &6000.
   2. Approved equal.

B. Product Description: Sheet metal channel with fitted cover, suitable for use as surface metal raceway.

C. Wireway systems smaller than Wiremold series 700, or equal are not permitted.

D. Finish: Gray enamel.

E. Fittings, Boxes, and Extension Rings: Furnish manufacturer's standard accessories; match finish on raceway.

2.10 WIREWAY

A. Product Description: Steel, general purpose or Raintight type wireway.

B. Finish: Rust inhibiting primer coating with gray enamel finish.

C. Wireway systems shall have dividers between line voltage and low voltage systems.

2.11 OUTLET BOXES

A. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
   1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; furnish 1/2-inch male fixture studs where required.
   2. Boxes for shall be 1-1/2 inch deep by 4-inch square minimum.
   3. Concrete Ceiling Boxes: Concrete type.

B. Nonmetallic Outlet Boxes: NEMA OS 2.

C. Cast Boxes: NEMA FB 1, Type FD, cast ferroalloy. Furnish gasketed cover by box manufacturer. Furnish threaded hubs.

D. Wall Plates for Finished Areas: As specified in Section 26 27 26.

E. Wall Plates for Unfinished Areas: Furnish gasketed cover.

2.12 PULL, SPLICE 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. Boxes shall have hinged covers or flat removable, galvanized sheet metal covers held in place with binder head sheet metal screws.

B. Outdoor boxes surface mounted above ground in wet locations 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.

C. Size boxes based on code and working space requirements related to the number and size of conduits and wire entering the box.

D. For recessed boxes, use an outside flanged recessed cover. For outdoor boxes mounted on exterior surfaces, use an un-flanged box with weather seals.

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 above ground general purpose where size and capacity are acceptable by code.

G. Boxes shall be of the depth required for wiring capacity.

H. Above ground outdoor boxes shall be cast iron with threaded hubs for vapor tight and wet locations where indicated.

I. Boxes for hazardous (classified) locations shall be approved for the classification and use.

J. Provide boxes with a blank cover.

K. Hinged Enclosures: As specified in Section 26 27 16.

2.13 UNDERGROUND BOXES

A. Underground boxes 24-inches square or larger shall be high density reinforced concrete with end and side knockouts. All such boxes shall be back filled around the outside with concrete. Each shall be equipped with the following reinforced concrete accessories:

1. Extensions as required
2. Box floor
3. Lid with hold down bolts and labeled with usage. (Steel checker plate with hold down bolts in traffic areas.)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify outlet locations and routing and termination locations of raceway prior to rough-in.

3.2 EXISTING WORK

A. Remove exposed abandoned raceway, including abandoned raceway above accessible ceiling finishes. Cut raceway flush with walls and floors, and patch surfaces.

B. Remove concealed abandoned raceway to its source.

C. Disconnect abandoned outlets and remove devices. Remove abandoned outlets when raceway is abandoned and removed. Install blank cover for abandoned outlets not removed.

D. Maintain access to existing boxes and other installations remaining active and requiring access. Modify installation or provide access panel.

E. Extend existing raceway and box installations using materials and methods as specified.

F. Clean and repair existing raceway and boxes to remain or to be reinstalled.

3.3 INSTALLATION

A. Contractor shall have reviewed and approved Seismic Shop Drawings prior to installation of raceways which require seismic support.

B. Ground and bond raceway and boxes in accordance with Section 26 05 26.

C. Fasten raceway and box supports to structure and finishes in accordance with Section 26 05 29.

D. Identify raceway and boxes in accordance with Section 26 05 53.

E. Arrange raceway and boxes to maintain headroom and present neat appearance.

F. Maintain minimum 12” clearance from top of suspended ceiling to bottom of conduits where possible.

G. Electrical wiring, conduits and boxes may not be installed within 1 ½” of metal deck roofs.

3.4 INSTALLATION - RACEWAY

A. Provide completely separate raceways for the life safety, critical, equipment, and normal branch power systems in accordance with the CEC.

B. Conceal all conduits, except in unfinished spaces such as equipment rooms or were indicated by symbol on the drawings or as approved by the University's Representative. Run concealed in areas having finished ceilings and furred walls.

C. Support raceway using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.

D. Group related raceway; support using conduit rack. Construct rack using steel channel specified in Section 26 05 29; provide space on each for 25 percent additional raceways.

E. Do not support raceway with wire or perforated pipe straps. Remove wire used for temporary supports.

F. Do not attach raceway to ceiling support wires or other piping systems.

G. Construct wireway supports from steel channel specified in Section 26 05 29.

H. Route exposed raceway parallel and perpendicular to walls.

I. Do not route flexible conduit through rated or non-rated walls.

J. Route raceway installed above accessible ceilings parallel and perpendicular to walls.

K. Maintain clearance between raceway and piping for maintenance purposes.

L. Maintain 2-inch clearance between raceway running perpendicular to piping with temperatures exceeding 104 degrees F.

M. Maintain 12-inch clearance between raceway and surfaces with temperatures exceeding 104 degrees F.

N. Cut conduit square using saw or pipe cutter; de-burr cut ends.

O. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for minimum 20 minutes.

P. Install conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.

Q. Provide pull boxes or junction boxes in conduit runs over 90' long or when more than 4 quarter bends occur in a conduit run.

R. Install conduit bodies to make sharp changes in direction, as around beams.

S. Avoid moisture traps; install junction box with drain fitting at low points in conduit system.

T. Install fittings to accommodate expansion and deflection where raceway crosses seismic, control or expansion joints.

U. Fittings for IMC or rigid steel conduits shall be assembled with anti-corrosion, conductive anti-seize compound at joints made to exclude water.

V. Install suitable pull string or cord in each empty raceway except sleeves and nipples.

W. Surface Raceway: Install flat-head screws, clips, and straps to fasten raceway channel to surfaces; mount plumb and level. Install insulating bushings and inserts at connections to outlets and corner fittings.

X. Close ends and unused openings in boxes and wireway.

3.5 USES PERMITTED

A. Galvanized rigid conduit or IMC shall be used as follows:

1. 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.
2. Buried in or in contact with earth to be half-lapped with omic pipe wrapping tape with sealant applied to all joints.
3. In poured concrete walls, floor, and roof construction, provided a minimum of 2" of cover is maintained.

4. In all walls up to the first outlet box where fed from rigid conduit in damp locations or locations exposed to the weather.
5. In exposed locations below 8 feet above the floor, including all mechanical rooms.
6. All elbows for underground plastic conduit.
7. All conduits for interior wiring systems whose voltage is above 600 volts.
8. All conduits entering refrigerated spaces.
9. Elsewhere where indicated on the drawings.
10. For emergency branch feeders and circuits installed outside of building.

B. Electrical metallic tubing (EMT) shall be used as follows:

1. Concealed in stud partitions and hollow masonry walls.
2. For connections from junction box to lighting fixtures except in accessible ceilings.
3. In suspended or accessible ceilings above 8 feet.
4. Exposed in dry locations above 8 feet where not subjected to mechanical damage.
5. In furred ceiling spaces.

C. Rigid non-metallic conduit shall be used as follows:

1. For the branch circuit wiring for exterior lighting pole bases and bollards (horizontal runs only).
2. All elbows, both vertical and horizontal, shall be GRC.
3. Any non-metallic PVC conduit used for emergency power systems shall be schedule 80 PVC.
4. The communications conduit shall be schedule 40 PVC.

D. Flexible steel conduit shall be used as follows:

1. Recessed lighting fixtures. (6ft max)
2. Motor connections.
3. Connection between fan plenum and structure.
4. At expansion joints.
5. At transformers and other equipment which produces vibration.
6. At damp and wet locations or where exposed to weather, flexible steel conduit shall be liquid tight type.
7. Up to 20 feet of length is permitted between receptacles and light fixtures within the same single room.
8. Tite-bite type connectors shall be used.
9. All flexible steel conduit shall be used with code sized ground wire installed.
10. All homeruns shall be in conduit, do not use flexible conduits for any homeruns routed to panels.

E. 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).

F. Conduit types shall not be mixed indiscriminately with other types in the same run, unless specified herein or required by the CEC.

G. Use flexible conduit for connections to motors, dry type transformers, electrical duct heaters, unit heaters, and flush mounted lighting fixtures. Conduit must be secured.

1. Flexible conduit used for connection of motor, dry type transformers, electric duct heaters, and unit heaters, shall not exceed 18" in length.
2. Flexible conduit from outlet box to flush mounted lighting fixture shall not exceed 6 feet in length.

3. Maintain ground continuity through flexible conduit with green equipment grounding conductor; do not use flexible conduit for ground continuity.
4. 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.

H. 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.

I. Where hazardous locations, as classified by the CEC, exist, all conduits and fittings and the installation of these materials shall comply with Article 500.

J. Direct Burial PVC Conduit
1. Minimum size 1.0”.
2. Unless otherwise indicated install top of conduits 24" minimum 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.
3. Install top of conduits 30" minimum below grade, below roads and any other paved surfaces.
4. Place a 4" wide, bright yellow, non-biodegradable plastic tape 12" above all underground conduit outside of building foundation.
5. Where transition is made from below grade PVC installation to a metallic conduit system above grade or slab, 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 for 6" above and below concrete surface.
6. For all underground runs of two or more conduits, separators or spacing blocks made of plastic or other suitable nonmetallic, non-decaying 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.

K. Raceway Installations Within Concrete
1. 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.
2. Conduit stub-up penetrations through slabs shall be installed with the top of a threaded conduit coupling flush with the finished slab.
3. Protect all conduits entering and leaving concrete floor slabs from physical damage during construction.

3.6 INSTALLATION - BOXES

A. Boxes for Concealed Conduits:
1. Flush mounted.
2. Provide raised covers for boxes to suit the wall or ceiling, construction, and finish.

B. Install wall mounted boxes at elevations to accommodate mounting heights as indicated on Drawings.

C. Adjust box location up to 10 feet prior to rough-in to accommodate intended purpose.

D. Orient boxes to accommodate wiring devices oriented as specified in Section 26 27 26.

E. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.

F. In Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 24 inches from ceiling access panel or from removable recessed luminaire.

G. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.

H. Provide acoustical rated moldable putty pads for all boxes located in acoustic rated walls.

I. Provide fire rated moldable putty pads for all boxes located in fire rated walls.

J. Secure flush mounting box to interior wall and partition studs with screws, not nails. Use box support bracket with far side support leg for outlets installed on wall studs.

K. Install stamped steel bridges to fasten flush mounting outlet box between studs.

L. Install flush mounting box without damaging wall insulation or reducing its effectiveness.

M. Install adjustable steel channel fasteners for hung ceiling outlet box.

N. Do not fasten boxes to ceiling support wires or other piping systems.

O. Support boxes independently of conduit.

P. Install gang box where more than one device is mounted together. Do not use sectional box.

Q. Install gang box with plaster ring for single device outlets.

R. Outlet boxes located below eight feet in exposed interior dry locations shall be one piece drawn steel or cast type.

3.7 INSTALLATION CONCRETE COMPOSITE BOXES

A. Install boxes direct buried in earth or concrete flush with surface, square with surrounding structures.

B. Provide hold down bolts for all covers.

C. Provide minimum 12” depth of crushed rock or pea gravel below boxes for drainage. Ground bond steel cover plate with insulated green grounding conductor.

D. Install suitable caps to protect installed conduit against entrance of dirt and moisture.

3.8 INTERFACE WITH OTHER PRODUCTS

A. Install conduit to preserve fire resistance rating of partitions and other elements.

B. Route conduit through roof openings for piping and ductwork or through suitable roof jack with pitch pocket. Coordinate location with roofing installation specified in other Sections.

C. Locate outlet boxes to allow luminaires positioned as indicated on Drawings.

D. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.

3.9 ADJUSTING

A. Adjust flush-mounting outlets to make front flush with finished wall material.

B. Install knockout closures in unused openings in boxes.

3.10 CLEANING

A. Clean interior of boxes to remove dust, debris, and other material.

B. Clean exposed surfaces and restore finish.

END OF SECTION

SECTION 260553
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Nameplates.
   2. Wire markers.
   3. Junction box identification.
   4. Inscribed cover plates.
   5. Underground Warning Tape.

1.2 QUALITY ASSURANCE

A. Provide material supplied by a manufacturer producing identification systems

B. Comply with OSHA, NFPA or local jurisdiction identification requirements for electrical systems.

1.3 ENVIRONMENTAL REQUIREMENTS

A. Install labels or nameplates only when ambient temperature and humidity conditions for adhesive are within range recommended by manufacturer.

PART 2 - PRODUCTS

2.1 NAMEPLATES

A. Provide engraved plastic-laminate sign on each major unit of electrical equipment in building, including:
   1. Electrical cabinets, panels, switchboards, and enclosures.
   2. Transformers.

B. Each individually mounted circuit breaker, and each breaker in the switchboards, secondary unit substations, and distribution panels shall have a nameplate.

C. Nameplates shall have ½” high text lettering on 1-1/2” high nameplate (with 2” high used for nameplates with multiline text).

D. Nameplates shall be color coded to match existing electrical system.

E. Equipment identification is to indicate the following:
   1. Equipment ID abbreviation.
   2. Voltage, phase, and wires.
   3. Power source description or system.
   4. Power source origination.
   5. Example: Panel SLGHA1; 480/277V, 3 Ø, 4 W.
   6. Life Safety System; Fed by EM1

F. Minimum nameplate thickness: 1/16 inch for signs up to 20 square inches, or 8 inches in length; 1/8 inch thick for larger sizes. Furnish with pre-punched holes for mechanical fasteners.

G. All electrical devices and switches shall have engraved device covers, 1/8” high letters. Include panel name and circuit number.

2.2 BOX IDENTIFICATION:

A. 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.

B. After box installation and wire termination completion all junction box and pull box covers shall be field marked/painted as follows:
   1. Normal branch power circuits "Green"
   2. Emergency branch power circuits "Red"

2.3 WIRE MARKERS

A. Description: Self-adhering, pre-printed or machine printable, self-laminating vinyl wrap around strips. Inscribe blank markers using the printer recommended by the manufacturer for this purpose.

B. All conductors shall be marked and identified. Include 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.

C. Legend:
   1. Power and Lighting Circuits: Branch circuit or feeder number as indicated on Drawings.
   2. Control Circuits: Control wire number as indicated on shop drawings.

2.4 CONDUCTOR PHASE MARKERS

A. Colored vinyl plastic electrical tape, 3/4 inch wide, for identification of phase conductors.

2.5 UNDERGROUND WARNING TAPE

A. Description: 6-inch-wide plastic tape, detectable type, colored yellow or red with suitable warning legend describing buried electrical lines.

2.6 LOCKOUT DEVICES

A. Lockout Hasps:
   1. Anodized aluminum hasp with erasable label surface; size minimum 7-1/4 x 3 inches.

PART 3 - EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 EXISTING WORK

A. Install identification on existing equipment to remain in accordance with this section.

B. Install identification on unmarked existing equipment.

C. Replace lost nameplates, labels, and markers.

D. Provide updated, type written, panelboard schedules for all branch circuit work completed as part of renovation and/or new construction projects. Schedules shall include the load description and the room number or area installed.

3.3 INSTALLATION

A. Install identifying devices after completion of painting.

B. Nameplate Installation:
   1. Install nameplate parallel to equipment lines.
   2. Install nameplates for each control panel and major control components located outside panel with corrosive-resistant mechanical fasteners.
   3. Fasteners for equipment or device tag identification shall be self-tapping stainless-steel screws, except contact-type permanent adhesive where screws cannot be used or should not penetrate the substrate material of the equipment.

C. Nameplates for signal systems equipment and devices are to be black except as follows:
   1. Fire alarm and life safety - White with red letters

D. Inscribed Electrical Device Cover plate:
   1. General: Lettering type shall be Helvetica, 12 point or 1/8" high. Color of characters shall be black. Locate the top of the inscription 1/2" below the top edge of the cover plate. Inscription shall be centered and square with cover plate.
   2. Provide inscribed cover plates for devices as outlined below:
      a. Receptacles and switches.
      b. Outlets in surface raceways.
      c. Multi-ganged (four or more) switch arrangement.
      d. Special purpose switches, i.e., projection screens, shades, exhaust fans, etc.

E. Wire Marker Installation:
   1. Install wire marker for each conductor at panelboard gutters, pull boxes, outlet and junction boxes, and each load connection.
   2. Provide colored plastic phase tape in half-lapped turns for a distance of 3 inches from terminal points and in boxes where splices or taps are made.

F. Box Identification:
   1. After completion, using an indelible wide tip marker, indicate on the cover of each junction and pull box the designation of the circuits contained therein, i.e., A-1, 3, 5.
   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.

G. After box installation and wire termination completion all junction box and pull box covers shall be field marked/painted as follows:
   1. Normal branch power circuits "Green"
   2. Emergency branch power circuits "Red"

H. Conduit and Raceway 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.

3.4 UNDERGROUND WARNING TAPE:

A. Install underground warning tape along length of each underground conduit, raceway, or cable 6 to 8 inches below finished grade, directly above buried conduit, raceway, or cable.

3.5 BRASS TAGS:

A. Provide brass tags for all feeder cables in underground vaults and pull boxes.

B. Provide brass tags for empty conduits in underground vaults, pull boxes and stubs.

3.6 WARNING, CAUTION, AND INSTRUCTION SIGNS

A. Provide warning, caution or instruction signs where required by OSHA, where indicated, or where reasonably required to assure safe operation and maintenance of electrical systems.
   1. Install engraved plastic-laminated instruction signs with approved legend where instructions or explanations are needed for system of equipment operation
   2. Provide polyester film self-adhesive signs of indoor/outdoor equipment and door warning. Use rigid polyethylene non-adhesive signs where adhesives will not work; for example, installing on a metal fence. Provide sign color and marking that meets OSHA regulations. For example, DANGER (red background with white letters), HIGH VOLTAGE (white with black letters.
      a. Use 2 by 4-inch signs for small equipment or enclosure doors.
      b. Use 7 by 10 inch or 10 by 14-inch signs for large equipment or enclosure doors.

B. Emergency Operating Signs: Install engraved laminate signs with white letters on red background with minimum 3/8-inch-high lettering for emergency instructions on power transfer, load shedding, or other emergency operations.

3.7 FIRESTOPPING

A. Firestopping shall be labeled at each location where installed, on each side of the penetrated fire barrier, and within 12 in. of the firestopping material.

END OF SECTION

SECTION 260573
SHORT-CIRCUIT/COORDINATION STUDY AND ARC FLASH HAZARD ANALYSIS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes short circuit and protective device coordination studies encompassing portions of electrical distribution system from normal power source or sources up to and including breakers in service entrance switchboard, main breaker in sub-distribution panels, and main breaker in each panelboard.

B. The contractor shall furnish an Arc Flash Hazard Analysis Study per NFPA 70E - Standard for Electrical Safety in the Workplace, reference Article 130.3 and Annex D.

C. Related Sections:
   1. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
   2. Section 26 22 00 - Low-Voltage Transformers.
   3. Section 26 24 16 - Panelboards.
   4. Section 26 28 19 - Enclosed Switches.
   5. Section 26 28 23 - Enclosed Circuit Breakers.

1.2 REFERENCES

A. International Electrical Testing Association:
   1. ANSI/NETA ATS – 2017 Acceptance Testing Specifications for Electrical Power Equipment and Systems.

B. Institute of Electrical and Electronics Engineers:
   1. IEEE 242 - Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems (Buff Book).

C. Part 3, Title 24, - California Electrical Code (CEC).

D. IEEE 1584 – Guide for Performing Arc-Flash Hazard Calculations

E. NFPA 70E – Standard for Electrical Safety in the Workplace

1.3 SHORT CIRCUIT AND PROTECTIVE DEVICE COORDINATION STUDY

A. Complete Short Circuit, Protective Device Coordination Study and Arc Flash Hazard Analysis to meet requirements of NFPA 70.

B. Report shall demonstrate that all emergency system overcurrent devices are selectively coordinated to restrict outages to the circuit or equipment affected. This shall be accomplished by providing overcurrent protective devices and their ratings or settings, utilizing the 0.10 second level of the overcurrent protective device from the time-current curve as the basis for the lower limit of the calculation method.

C. Report Preparation:

1. Prepare study prior to ordering distribution equipment to verify equipment ratings required.
2. Perform study with aid of computer software program.
3. Obtain actual settings for equipment incorporated into Work.
4. Calculate short circuit interrupting and, when applicable, momentary duties for assumed 3-phase bolted fault short circuit current and phase to ground fault short circuit current at each of the following:
    a. Low-voltage switchgear.
    b. Switchboards.
    c. Distribution panelboards.
    d. Branch circuit panelboards.
    e. Each other significant equipment location throughout system.

D. Report Contents:

1. Include the following:
    a. Calculation methods and assumptions.
    b. Base per unit value selected.
    c. One-line diagram.
    d. Source impedance data including power company system available power and characteristics.
    e. Typical calculations.
        1) Fault impedance.
        2) X to R ratios.
        3) Asymmetry factors.
        4) Motor fault contribution.
        5) Short circuit kVA.
        6) Symmetrical and asymmetrical phase-to-phase and phase-to-ground fault currents.
        7) Tabulations of calculation quantities and results.
    f. One-line diagram revised by adding actual instantaneous short circuits available.
    g. Incident energy and flash protection boundary calculations.
    h. State conclusions and recommendations.
2. Prepare time-current device coordination curves graphically indicating coordination proposed for system, centered on conventional, full-size, log-log forms.
3. Prepare with each time-curve sheet complete title and one-line diagram with legend identifying specific portion of system covered by that particular curve sheet.
4. Prepare detailed description of each protective device identifying its type, function, manufacturer, and time-current characteristics. Tabulate recommended device tap, time dial, pickup, instantaneous, and time delay settings.
5. Plot device characteristic curves at point reflecting maximum symmetrical fault current to which device is exposed. Include on curve sheets the following:
    a. Low voltage equipment circuit breaker trip device characteristics.
    b. Low voltage equipment fuse characteristics.
    c. Cable damage point characteristics.
    d. Pertinent transformer characteristics including:
        1) Transformer full load current.
        2) Transformer magnetizing inrush.
        3) ANSI transformers withstand parameters.

4) Significant symmetrical fault current.

e. Pertinent motor characteristics.

f. Generator characteristics including:

1) Phase and ground coordination of generator protective devices.
2) Decrement curve and damage curve.
3) Operating characteristic of protective devices.
4) Actual impedance value.
5) Time constants.
6) Current boost data.
7) Do not use typical values for generator.

g. Transfer switch characteristics.

h. Other system loads protective device characteristics.

1.4 Arc Flash Hazard Analysis

A. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2018, Annex D.

B. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Alternative methods shall be presented in the proposal.

C. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboards, equipment disconnects, busway and splitters) where work could be performed on energized parts.

D. The Arc-Flash Hazard Analysis shall include all MV, 575v, & 480v locations and significant locations in 240 volt and 208-volt systems.

E. Safe working distances shall be specified for calculated fault locations based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm^2.

F. For arc flash calculations, the worst-case scenario is not always described by the greatest magnitude of fault current. The Arc Flash Analysis shall use the maximum and minimum available fault current available at the utility to consider several scenarios and providing a worst-case scenario for each system location. The arc flash analysis will, therefore, include calculations for maximum and minimum contributions of fault current magnitude.

G. Motors receiving power via variable frequency drives are not considered to have fault contributions. All motors less than 50hp shall be lumped into a single motor model. All motors are to be considered running (contributing).

H. Arc flash computation shall include both line and load side of main breaker calculations, where necessary. The worst-case scenario incident energy value (Cal/cm2) shall be applied to the Arc Flash label.

I. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584-20018 section B.1.2.

1.5 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Qualifications Data: Submit the following for review prior to starting study.
   1. Submit qualifications and background of firm.
   2. Submit qualifications of Professional Engineer performing study.

C. Software: Submit for review information on software proposed to be used in performing study.

D. Product Data: Submit the following:
   1. Short Circuit and Coordination Study: Summarize results of study in report format including the following:
      a. Descriptions, purpose, basis, and scope of study.
      b. Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short-circuit duties, and commentary regarding same.
      c. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip settings, fuse selection, and commentary regarding same.
      d. Fault current calculations including definition of terms and guide for interpretation of computer printout.
   2. Incident energy and flash protection boundary calculations.
      a. Arcing fault magnitude
      b. Device clearing time
      c. Duration of arc
      d. Arc flash boundary
      e. Working distance
      f. Incident energy
      g. Hazard Risk Category
      h. Recommendations for arc flash energy reduction

E. Submit copies of final report signed by professional engineer. Make additions or changes required by review comments from EEOR.

1.6 QUALITY ASSURANCE

A. Maintain one copy of document on site.

B. Use commercially available software, designed specifically for short circuit and protective device coordination studies with minimum of 5 years availability approved by Architect/Engineer.

C. Perform study in accordance with IEEE 242.

1.7 QUALIFICATIONS

A. Study Preparer: Company specializing in performing work of this section with minimum 5 years experience.

B. Perform study under direct supervision of Professional Engineer experienced in design of this Work and licensed in State of California five years' experience in power system analysis.

C. Demonstrate company performing study has capability and experience to help during system start up.

1.8 SEQUENCING

A. Allow 2 weeks for review of completed study by Architect/Engineer.

B. Submit short circuit protective device coordination study and arc flash hazard analysis studies to Architect/Engineer prior to receiving final approval of distribution equipment shop drawings and prior to releasing equipment for manufacturing.

C. When formal completion of study will cause delay in equipment manufacturing, obtain approval from Architect/Engineer for preliminary submittal of study data sufficient in scope to ensure selection of device ratings and characteristics will be satisfactory.

1.9 SCHEDULING

A. Schedule work to expedite collection of data to ensure completion of study for final approval of distribution equipment shop drawings prior to release of equipment for manufacturing.

1.10 COORDINATION

A. Coordinate work with local power company.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 FIELD QUALITY CONTROL

A. Aid electrical distribution system equipment manufacturer during start up of electrical system and equipment.

3.2 ADJUSTING

A. Perform field adjustments of protective devices and modifications to equipment to place equipment in final operating condition. Adjust settings in accordance with approved short circuit and protective device coordination study.

3.3 ARC FLASH WARNING LABELS

A. The vendor shall provide a 4 in. x 6 in. thermal transfer type label of high adhesion polyester for each work location analyzed.

B. The label shall have an orange header with the wording, “WARNING, ARC FLASH HAZARD”, and shall include the following information:

1. Location designation
2. Nominal voltage
3. Flash protection boundary
4. Incident energy
5. Working distance
6. Engineering report number, revision number and issue date

C. Labels shall be machine printed, with no field markings

D. Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings.

1. For each 600, 480 and applicable 208-volt panelboards and disconnects, one arc flash label shall be provided
2. For each motor control center, one arc flash label shall be provided
3. For each low voltage switchboard, one arc flash label shall be provided
4. For each switchgear, one flash label shall be provided
5. For medium voltage switches one arc flash label shall be provided

3.4 AVAILABLE FAULT CURRENT LABEL

A. The vendor shall provide a 4 in. x 6 in. thermal transfer type label of high adhesion polyester for each work location analyzed.

B. The label shall have the wording, “AVAILABLE FAULT CURRENT”, and shall include the following information:

1. Project Name
2. Fault Name
3. Available Fault Current
4. Voltage
5. Date of Calculation

3.5 ARC FLASH TRAINING

A. The equipment vendor shall train personnel of the potential arc flash hazards associated with working on energized equipment (minimum of 4 hours). Maintenance procedures in accordance with the requirements of NFPA 70E, Standard for Electrical Safety Requirements for Employee Workplaces, shall be provided in the equipment manuals. The training shall be certified for continuing education units (CEUs) by the International Association for Continuing Education Training (IACET).

END OF SECTION

SECTION 262200
LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 SUMMARY

A. Aluminum-wound transformer meeting US Department of Energy proposed Candidate Standard Level (CSL) 3 efficiency, with extremely low no load losses.
   1. Transformers shall be designed to an efficiency standard higher than NEMA TP-1, the lowest legal efficiency for the following purposes:
   2. Delivering lowest life cycle cost according to the US Dept. of Energy
   3. Contributing to LEED Energy & Atmosphere Credit 1 (Optimize Energy Performance)
   4. Providing the basis for Utility Rebates.

B. Transformers designed to the lowest legal efficiency standard, thus not providing the contributions listed above, are not acceptable for meeting the requirements of this specification.

C. Transformer efficiency performance is the essence of this specification. Therefore, trans-formers shall meet the specified performance values, Transformers that are supplied on the project will be tested for conformance with these performance values. Transformers not meeting the specified performance values shall be removed and replaced.

D. Related Sections:
   1. Section 26 05 33 - Raceway and Boxes for Electrical Systems.
   2. Section 26 05 53 – Identification for Electrical Systems.

1.2 REFERENCES

A. National Electrical Manufacturers Association:
   1. NEMA ST 1 - Specialty Transformers (Except General Purpose Type).
   2. NEMA ST 20 - Dry Type Transformers for General Applications.
   3. NEMA TP 1 Efficiency Standards.

B. DOE (Department of Energy)
   1. Standard Level Three (CSL-3) for Energy Efficiency.
   2. DOE 78 FR 23335 (April 18, 2013), Energy Conservation Standards for Distribution Transformers.

C. International Electrical Testing Association:
   1. ANSI/NETA ATS 2017 - Acceptance Testing Specifications for Electrical Power Equipment and Systems.

D. California Code of Regulations Title 20 and Title 24.

E. IEEE C57.110-1998 – IEEE Recommended Practice for establishing transformer capability when feeding non-sinusoidal load currents

F. IEEE-1100 – Recommended Practice for Powering and Grounding Sensitive Electronic Equipment

G. LEED – Leadership in Energy and Environmental Design, U.S. Green Building Council.

H. ISO 9000:2000 – International Standards Organization - Quality Management System

I. ISO 14000:2004 – International Standards Organization - Environmental Management System

1.3 SUBMITTALS

A. Product Data: Submit outline and support point dimensions of enclosures and accessories, unit weight, voltage, kVA, and impedance ratings and characteristics, tap configurations, insulation system type, and rated temperature rise.

B. Seismic Qualification: Submit manufacturer's certificate of seismic compliance in accordance with the American Society of Civil Engineers ASCE/SEI 7-05 and the California Building Code.

C. Submit product data including the following:

1. Copy of ISO 14001:2004 Certification
2. Copy of ISO 9001:2000 Certification
3. Documentation of the integrated transformer meter, and how it interfaces to education for sustainability software.
4. Insulation system impregnant data sheet as published by supplier.
5. Construction details including enclosure dimensions, kVA rating, primary & secondary nominal voltages, voltage taps, BIL, unit weight
6. Basic Performance characteristics including insulation class, temperature rise, core and coil materials, impedances & audible noise level, unit weight
7. Inrush Current (typical 3 cycle recovery)
8. Short Circuit Current data: Primary (Sym. O/P S/C) & Secondary (L-N/G S/C)
    a. Efficiency Data
    b. No load and full load losses per NEMA ST20
    c. Linear load Efficiency data @ 1/6 load
    d. Linear load efficiency data @ ¼, ½, ¾ & full load
    e. Linear Load Efficiency @ 35% loading tested per NEMA TP-2.
    f. Efficiency under K-4 load profile at 15%, 25%, 50%, 75%, 100% of nameplate rating.
9. Description of manufacturer's factory nonlinear load test program
    a. Factory ISO 9001 procedure describing nonlinear load test program
    b. Meter and CT details including model, accuracy, serial numbers, and calibration information.
    c. Copy of Linear & Nonlinear load test report for a representative 75-kVA trans-former
10. 25-year Product Warranty Certificate
    a. Documentation that materials used for shipment packaging meet the environmental requirements identified in section 1.4 below. Provide a representative picture of the packaging materials.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years' experience.

B. The equipment and major components shall be suitable for and certified by actual seismic testing to meet all applicable seismic requirements of the 2006 International Building Code.

C. The following minimum mounting and installation guidelines shall be met, unless specifically modified by the above referenced standards.

1. The Contractor shall provide equipment anchorage details, coordinated with the equipment mounting provision, prepared, and stamped by a licensed civil engineer in the state. Mounting recommendations shall be provided by the manufacturer based upon the above

criteria to verify the seismic design of the equipment.

2. The equipment manufacturer shall certify that the equipment can withstand, that is, function following the seismic event, including both vertical and lateral required response spectra as specified in above codes.
3. The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment. Seismic qualification shall be considered achieved when the capability of the equipment, meets or exceeds the specified response spectra.

1.5 MANUFACTURER'S FACTORY NONLINEAR LOAD TEST PROGRAM

A. The nonlinear load bank shall consist of a phase-neutral loading with a K-4 profile, representative of a mix of typical commercial equipment.

B. Meters and CTs shall both be revenue class accurate. CTs shall be operated within their approved accuracy loading range. Dual meters shall gather simultaneous primary and secondary energy and harmonic data. Meter and CT details including model, accuracy, serial numbers, and calibration information.

C. Efficiency: Measurements shall be taken at multiple load levels and plotted to show compliance with specification and correlation to the designed efficiency curve.

D. Efficiency shall be determined purely by measurements using method and instrumentation per NEMA TP-2 Standard. Other methods are not acceptable.

E. Harmonic data including current and Voltage THD at the different load levels shall be included with the test report.

1.6 PACKAGING FOR SHIPMENT

A. Transformers shall be packaged for shipment using materials that will have the least environmental impact:

1. Transformer Wrapping
   a. Transformers shall be wrapped for shipment in a film coating that is 100% compostable and biodegradable.
2. Transformer Shipping Base
   a. Transformers shall be shipped on a base that uses at least 50% less wood than traditional pallets.
   b. Wood used in the shipping base shall be Forestry Stewardship Council (FSC) certified as having been sustainably harvested.
3. Shall minimize or eliminate use of materials that are not commonly recycled at the destination.
4. Shall minimize labor, risk of injury and equipment damage, while handling from initial transportation through to final placement of the transformer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

1.8 WARRANTY

A. Transformer shall carry a 25-year pro-rated warranty, which shall be standard for the product line.

1.9 ON-SITE PERFORMANCE VALIDATION

A. To ensure that the products shipped to the job site meet this specification, provide on-site revenue class accurate efficiency and harmonic measurements of transformers once in-stalled and operating at customer's site. Data shall be collected from primary and secondary sides of the transformer simultaneously on a synchronized cycle by cycle basis. The use of two discrete meters that are not synchronized is not acceptable. Sampling shall be of 10% of transformers on the project once installed and operating, as selected by custom-er.

B. Demonstrate use of the transformer's integrated efficiency and power quality meter where specified.

1.10 INTERNATIONAL STANDARDS ORGANIZATION REGISTRATION

A. Registration to current ISO standard is required.

B. Independent annual audits are conducted.

C. ISO 9001:2000 Registered – Quality Management System

D. ISO 14001:2004 Registered – Environmental Management System

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS/PRODUCT

A. Powersmiths International Corp. ("OPAL" Series) OR others meeting the Performance requirements of this specification.

B. Manufacturers wishing to have products evaluated for acceptability and conformance with the performance requirements of this specification, shall provide detailed compliance and/or exception statements, along with the documentation identified in Section 1.3 (above) and test documentation, signed by an engineer, that confirms that the transformer(s) meet the no load losses and efficiency levels identified in Section 2.3 (below).

C. Failure to provide the required documentation no less than 7 days prior to the bid date will disqualify products from consideration for this project.

D. Primary Voltage: 480 volts, 3 phases.

E. Secondary Voltage: 208Y/120 volts, 3 phases.

F. Compatibility: This product must facilitate the ability of the electrical system to supply a sinusoidal voltage in order to improve the long-term compatibility of the electrical system with all types of linear and nonlinear connected loads today and in the future. All national and international standards on harmonics and power quality set limits on levels of voltage distortion to maintain compatibility.

G. Aluminum-wound, 3-phase, common core, ventilated, dry-type, isolation transformer built to NEMA ST20 and relevant NEMA, UL and IEEE standards; 200% rated neutral; 60Hz rated; Transformers 750 kVA and less, 600 volts primary and less, shall be U.L. and CSA Listed and

bear the label. All terminals, including those for changing taps, must be readily accessible by removing a front cover plate. Windings shall be continuous with terminations brazed or welded. 10kV BIL.

H. Insulation System:
   1. Shall be NOMEX-based with an Epoxy Co-polymer impregnant for lowest environmental impact, long term reliability and long-life expectancy
      a. Class: 220°C
      b. Impregnant Properties for low emissions during manufacturing, highest reliability, and life expectancy
      c. Epoxy co-polymer
      d. VOC: less than 1.65 lbs./gal. (low emissions during manufacturing)
      e. Water absorption (24hrs @25°C): less than 0.05% (superior insulation, longer life)
      f. Chemical Resistance: Must have documented excellent performance rating by supplier
      g. Dielectric Strength: minimum of 3200 volts/mil dry (for superior stress, overvoltage tolerance)
      h. Dissipation Factor: max. 0.02 @25°C to reduce aging of insulation, extending useful life

I. Operating Temperature Rise: 130°C in a 40°C maximum ambient

J. Noise levels:
   1. Per NEMA ST-20
   2. Production Test every unit. Data to be available upon request.

K. UL Listed & Labeled K-Rating: K-4 or higher

L. Maximum No Load Losses shall not exceed:
   1. 15kVA: 60W
   2. 30kVA: 99W
   3. 45kVA: 130W
   4. 75kVA: 185W
   5. 112.5kVA: 260W
   6. 150kVA: 325W
   7. 225kVA: 450W
   8. 300kVA: 570W
   9. 500kVA: 850W
   10. 750kVA: 1200W

M. Efficiency at 1/6 loading shall meet or exceed:
   1. 15kVA: 97.0%
   2. 30kVA: 97.6%
   3. 45kVA: 97.8%
   4. 75kVA: 98.3%
   5. 112.5kVA: 98.5%
   6. 150kVA: 98.4%
   7. 225kVA: 98.6%
   8. 300kVA: 98.7%
   9. 500kVA: 98.8%
   10. 750kVA: 98.9%

N. Shall meet or exceed DOE 10 CFR Part 430 CSL 3 Efficiency requirements, tested per NEMA TP-2:

1. 15kVA: 97.6%
2. 30kVA: 98.1%
3. 45kVA: 98.3%
4. 75kVA: 98.6%
5. 112.5kVA: 98.8%
6. 150kVA: 98.9%,
7. 225kVA: 98.9%
8. 300kVA: 99.0%
9. 500kVA: 99.1%
10. 750kVA: 99.2%

O. Efficiency under k-4 nonlinear load at 50% of nameplate rating:

1. 15kVA: 97.2%
2. 30kVA: 97.7%
3. 45kVA: 97.9%
4. 75kVA: 98.1%
5. 112.5kVA: 98.5%
6. 150kVA: 98.7%
7. 225kVA: 98.8%
8. 300kVA: 98.8%
9. 500kVA: 98.9%
10. 750kVA: 99.1%

P. Voltage Taps: For transformers 30kVA-300kVA, provide two 2-1/2% full capacity taps above and below nominal primary voltage. For transformers 15kVA and smaller as well as 500kVA and larger provide one 5% full capacity tap above and below nominal primary voltage.

Q. Impedance: Between 3.5% and 5.8% unless otherwise noted.

R. Enclosure type: Ventilated NEMA 2, drip-proof

S. Maximum Footprint for 130°C rise model in a NEMA 2 enclosure:

1. 18” Wide x 17” Deep x 27” High for 15kVA.
2. 26” Wide x 18” Deep x 30” High for 30kVA, 45kVA
3. 32” Wide x 22” Deep x 40” High for 75kVA, 112.5kVA
4. 38” Wide x 27” Deep x 48” High for 150kVA
5. 38” Wide x 32” Deep x 52” High for 225kVA, 300kVA
6. 52” Wide x 38” Deep x 61” High for 500kVA
7. 64” Wide x 47” Deep x 67” High for 750kVA

T. ACCESSORIES

1. Manufacturer to provide a hinged access door on the front of the transformer with a built-in keyed lock.
2. 360-degree rotatable IR port.
3. Provide Lug Kit: Supply with standard screw-type lugs
4. Nameplate: Include transformer connection data.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify mounting supports are properly sized and located including concealed bracing in walls.

3.2 EXISTING WORK

A. Disconnect and remove abandoned transformers.

B. Maintain access and adequate ventilation to existing transformers and other installations remaining active and requiring access and ventilation. Modify installation or provide access panel or ventilation grilles.

C. Clean and repair existing transformers to remain or to be reinstalled.

3.3 INSTALLATION

A. Follow all national, state, and local codes with respect to transformer installation.

B. Set transformer plumb and level.

C. Use flexible conduit, in accordance with Section 26 05 33, 2 feet minimum length, for primary and secondary connections to transformer case. Make conduit connections to side panel of enclosure, except for floor mounted transformers fed from directly below enclosure.

D. Adjust transformer secondary voltages to provide the required voltage at the loads.

E. Transformers not specifically designed for wall mounting shall be spaced a minimum of 6 inches from adjacent walls, ceiling, and equipment.

F. Support transformers in accordance with Section 26 05 29.

1. Mount wall-mounted transformers using integral flanges or accessory brackets furnished by manufacturer.
2. Mount floor-mounted transformers on vibration isolating pads suitable for isolating transformer noise from building structure.
3. Mount trapeze-mounted transformers as indicated on Drawings.

G. Provide seismic restraints where required.

H. Mount floor-mounted transformers on vibration isolating pads suitable for isolating the transformer noise from the building structure.

I. Unless labeled otherwise, ventilated transformers shall have all sides located at least 6 inches away from walls or other obstructions.

J. Provide grounding and bonding connected to the following:

1. Primary feeder ground
2. Secondary feeder ground
3. Grounding electrode
4. Main bond jumper to neutral (when present).

3.4 FIELD QUALITY CONTROL

A. Upon completion of the installation, an infrared scan shall be provided for all bolted connections. Correct any deficiencies.

B. Adjust transformer secondary voltages to provide the required voltage at the loads.

C. Provide visual and mechanical inspection in accordance with NETA ATS, 7.2.1.1A.

D. Perform electrical tests in accordance with NETA ATS, 7.2.1.1B.

E. Provide written test results of insulation test and thermographic survey to Architect.

F. PERFORMANCE VALIDATION: To ensure that the products shipped to the job site meet this specification, provide on-site revenue class accurate efficiency and harmonic measurements of transformers once installed and operating at customer's site. Data shall be collected from primary and secondary sides of the transformer simultaneously on a synchronized cycle by cycle basis. The use of two discrete meters that are not synchronized is not acceptable. Sampling shall be of 10% of transformers on the project once installed and operating, as selected by customer. Submit a detailed report to the project engineer.

G. Where provided, connect the transformer's integrated efficiency and power quality meter to customer's building management system, network, or other system as specified.

3.5 ADJUSTING

A. Measure primary and secondary voltages and make appropriate tap adjustments.

END OF SECTION

SECTION 262416
PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes distribution and branch circuit panelboards.

B. Related Sections:
   1. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
   2. Section 26 05 53 - Identification for Electrical Systems.

1.2 REFERENCES

A. Institute of Electrical and Electronics Engineers:
   1. IEEE C62.41 - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.

B. National Electrical Manufacturers Association:
   1. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.
   2. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
   3. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.
   4. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
   5. NEMA PB 1 - Panelboards.
   6. NEMA PB 1.1 - General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.

C. International Electrical Testing Association:
   1. ANSI/NETA ATS 2017 - Acceptance Testing Specifications for Electrical Power Equipment and Systems.

D. Underwriters Laboratories Inc.:
   1. UL 67 - Safety for Panelboards.
   2. UL 1449 – Surge Protection Devices.

1.3 SUBMITTALS

A. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.

B. Product Data: Submit catalog data showing specified features of standard products and list the following information:
   1. Panel designation
   2. Voltage rating
   3. Current rating
   4. Top, bottom or through feed lugs, lug size
   5. Main overcurrent device size.
   6. Branch device schedule, listing size and poles
   7. Surface trim or recessed.

8. Fault current rating of the panel and devices
9. Circuit breaker mounting method - bolt-in.
10. Bus material.
11. Indicate any special requirements including key locking, split bus, contactor panels, double panels, or panels in special NEMA enclosures.
12. Indicate which panelboards are electronic grade.

C. Seismic Qualification: Submit manufacturer's certificate of seismic compliance in accordance with the American Society of Civil Engineers ASCE/SEI 7-05 and the California Building Code.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of panelboards and record actual circuiting arrangements.

B. Operation and Maintenance Data: Submit spare parts listing; source of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

B. The equipment and major components shall be suitable for and certified by actual seismic testing to meet all applicable seismic requirements of the California Building Code.

C. The following minimum mounting and installation guidelines shall be met, unless specifically modified by the above referenced standards.

1. The Contractor shall provide equipment anchorage details, coordinated with the equipment mounting provision, prepared, and stamped by a licensed civil engineer in the state. Mounting recommendations shall be provided by the manufacturer based upon the above criteria to verify the seismic design of the equipment.
2. The equipment manufacturer shall certify that the equipment can withstand, that is, function following the seismic event, including both vertical and lateral required response spectra as specified in above codes.
3. The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment. Seismic qualification shall be considered achieved when the capability of the equipment, meets or exceeds the specified response spectra.

1.6 MAINTENANCE MATERIALS

A. Furnish two of each panelboard key. Panelboards keyed alike.

PART 2 - PRODUCTS

2.1 BRANCH CIRCUIT PANELBOARDS

A. Manufacturers:

1. Square D.

B. Product Description: NEMA PB1, circuit breaker type, lighting, and appliance branch circuit panelboard.

C. Panelboard Bus: Copper, current carrying components, ratings as indicated on Drawings. Furnish copper ground bus in each panelboard. Furnish isolated ground bus were indicated on Drawings.

D. Ground Bus: 50% capacity of the phase bus with lugs and terminals for terminating the sizes and quantity of ground conductors indicated and required.

E. Provide 100 percent rated Neutral. For non-linear load applications subject to harmonics furnish 200 percent rated, plated copper, solid neutral.

F. Minimum fully rated Short Circuit Rating:

1. 10,000-amperes RMS at 208V, or as shown on Drawings.
2. 35,000-amperes RMS at 480V, or as shown on Drawings.

G. Panelboard breakers shall match the kAIC rating and manufacturer of the enclosure.

H. Molded Case Circuit Breakers: NEMA AB 1, bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles, Class A ground fault interrupter circuit breakers as indicated on Drawings.

1. Circuit breaker handle locks shall be provided for all circuits that supply emergency egress lights, energy management and control system (EMCS) panels and fire alarm panels.
2. Circuit breakers shall be molded case, thermal magnetic trip type with common trip handle for all poles.

I. Include adjustable trip breakers where required to achieve selective coordination or limit fault current as coordinated with the results of the contractor prepared power system study.

J. When indicated on the drawings provide a microprocessor-based GE ASPERMETER Series Panelboard Monitoring System. The system shall be provided with all features and requirements necessary to interface with the existing campus GE PMCS Systems and the existing campus JCI Metasys system. Upgrades in the existing GE PMCS and Metasys systems shall be provided as necessary to integrate the panelboard metering system.

K. Main circuit breakers shall be bus connected to the panel, vertically mounted, and not group aligned in branch breaker positions, include lock off hardware.

L. Enclosure: NEMA PB 1, Type 1.

M. Cabinet Box: 6 inches deep, 20 inches wide.

N. Trim: Cabinet front with concealed trim clamps and flush lock all keyed alike. Trim shall be dead front with metal frame index holder on inside of door. Panelboard enclosures shall be provided with either a flush or surface trim as indicated in the Panelboard Schedule or shown on the plan. Trim shall be painted baked on ANSI #61, light gray enamel. Covers shall be hinged so that they swing away to provide full access to the interior of the panel without removing the cover. Covers designed for more than one panel section shall not be permitted. Hinged type door covering all circuit breakers shall be included in all panel trims.

2.2 SURGE PROTECTION DEVICES

A. Electrical Requirements

1. Unit Operating Voltage – Refer to drawings for operating voltage and unit configuration.
2. Maximum Continuous Operating Voltage (MCOV) – The MCOV shall not be less than 115% of the nominal system operating voltage.
3. The suppression system shall incorporate thermally protected metal-oxide varistors (MOVs) as the core surge suppression component for the service entrance and all other distribution

levels. The system shall not utilize silicon avalanche diodes, selenium cells, air gaps, or other components that may crowbar the system voltage leading to system upset or create any environmental hazards.

4. Protection Modes – The SPD must protect all modes of the electrical system being utilized. The required protection modes are indicated by bullets in the following table:

	Protection Modes			
Configuration	**L-N**	**L-G**	**L-L**	**N-G**
Wye	●	●	●	●
Delta	**N/A**	●	●	**N/A**
Single Split Phase	●	●	●	●
High Leg Delta	●	●	●	●

5. Nominal Discharge Current (In) – All SPDs applied to the distribution system shall have a 20kA in rating regardless of their SPD Type (includes Types 1 and 2) or operating voltage. SPDs having an in less than 20kA shall be rejected.
6. ANSI/UL 1449 4th Edition Voltage Protection Rating (VPR) – The maximum ANSI/UL 1449 4th Edition VPR for the device shall not exceed the following:

MODES	208Y/120	480Y/277	600Y/347
L-N; L-G; N-G	700	1200	1500
L-L	1200	2000	3000

B. SPD Design

1. Maintenance Free Design – The SPD shall be maintenance free and shall not require any user intervention throughout its life. SPDs containing items such as replaceable modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.
2. Balanced Suppression Platform – The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV. Designs incorporating replaceable SPD modules shall not be accepted.
3. Electrical Noise Filter – Each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be up to 50 dB from 10 kHz to 100 MHz using the MIL-STD-220A insertion loss test method. Products unable able to meet this specification shall not be accepted.
4. Internal Connections – No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall be soldered, hardwired with connections utilizing low impedance conductors.
5. Monitoring Diagnostics – Each SPD shall provide the following integral monitoring options:
   a. Protection Status Indicators - Each unit shall have a green / red solid-state indicator

light that reports the status of the protection on each phase.

1) For wye configured units, the indicator lights must report the status of all protection elements and circuitry in the L-N and L-G modes. Wye configured units shall also contain an additional green / red solid-state indicator light that reports the status of the protection elements and circuitry in the N-G mode. SPDs that indicate only the status of the L-N and L-G modes shall not be accepted.
2) The absence of a green light and the presence of a red light shall indicate that damage has occurred on the respective phase or mode. All protection status indicators must indicate the actual status of the protection on each phase or mode. If power is removed from any one phase, the indicator lights must continue to indicate the status of the protection on all other phases and protection modes. Diagnostics packages that simply indicate whether power is present on a particular phase shall not be accepted.

b. Remote Status Monitor – The SPD must include Form C dry contacts (one NO and one NC) for remote annunciation of its status. Both the NO and NC contacts shall change state under any fault condition.
c. Audible Alarm and Silence Button – The SPD shall contain an audible alarm that will be activated under any fault condition. There shall also be an audible alarm silence button used to silence the audible alarm after it has been activated.
d. Surge Counter – The SPD shall be equipped with an LCD display that indicates to the user how many surges have occurred at the location. The surge counter shall trigger each time a surge event with a peak current magnitude of a minimum of 50 ± 20A occurs. A reset pushbutton shall also be standard, allowing the surge counter to be zeroed. The reset button shall contain a mechanism to prevent accidental resetting of the counter via a single, short-duration button press. In order to prevent accidental resetting, the surge counter reset button shall be depressed for a minimum of 2 seconds in order to clear the surge count total.
    1) The ongoing surge count shall be stored in non-volatile memory. If power to the SPD is completely interrupted, the ongoing count indicated on the surge counter's display prior to the interruption shall be stored in non-volatile memory and displayed after power is restored. The surge counter's memory shall not require a backup battery in order to achieve this functionality.

6. Overcurrent Protection
    a. The unit shall contain thermally protected MOVs. These thermally protected MOVs shall have a thermal protection element packaged together with the MOV in order to achieve overcurrent protection of the MOV. The thermal protection element shall disconnect the MOV(s) from the system in a fail-safe manner should a condition occur, that would cause them to enter a thermal runaway condition.
7. Fully Integrated Component Design – All of the SPD's components and diagnostics shall be contained within one discrete assembly. SPDs or individual SPD modules that must be ganged together in order to achieve higher surge current ratings or other functionality shall not be accepted.
8. Safety Requirements
    a. The SPD shall minimize potential arc flash hazards by containing no user serviceable / replaceable parts and shall be maintenance free. SPDs containing items such as replaceable modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.
    b. SPDs designed to interface with the electrical assembly via conductors shall require

no user contact with the inside of the unit. Such units shall have any required conductors be factory installed.

C. System Application

1. The SPD applications covered under this section shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category B, and A environments.

D. Surge Current Capacity – The minimum surge current capacity the device is capable of withstanding shall be as shown in the following table:

Minimum surge current capacity based on ANSI / IEEE C62.41 location category			
CATEGORY	Application	Per Phase	Per Mode
B	Distribution Panelboards	160 kA	80 Ka
A	Branch Panelboards	120 kA	60 kA

E. SPD Type – All SPDs installed on the load side of the service entrance disconnect shall be Type 1 or Type 2 SPDs.

PART 3 - EXECUTION

3.1 EXISTING WORK

A. Disconnect abandoned panelboards. Remove abandoned panelboards.

B. Maintain access to existing panelboard remaining active and requiring access.

C. Clean and repair existing panelboards to remain or to be reinstalled.

3.2 INSTALLATION

A. Install panelboards in accordance with NEMA PB 1.1.

B. Install panelboards plumb.

C. Install recessed panelboards flush with wall finishes.

D. Maximum height: 6’-6” to top of panelboard; install panelboards taller than 6 feet with bottom no more than 4 inches above floor.

E. Install filler plates for unused spaces in panelboards.

F. Provide 8 ½” by 11” minimum typed circuit directory with clear plastic covering inside panel door for each branch circuit panelboard. Contractor shall clearly identify locations and specific purpose of circuits.

G. Schedules shall include:

1. Panel designation.
2. Panel location.
3. Voltage, phase, current rating.
4. Main overcurrent device size.
5. Branch circuit listing indications circuit number and description of loads served.
6. Source of panel feeder.
7. Panel schedule book shall be assembled based on "As Built" information and submitted to

the University upon completion of the project. Provide one hard copy of book and provide one CD or Zip-disk containing updated panel schedules in MS Excel format.

H. Install engraved plastic nameplates in accordance with Section 26 05 53.

I. Install spare conduits out of each recessed panelboard to accessible location above ceiling. Minimum spare conduits: 3 empty 1 inch. Identify each as SPARE.

J. Ground and bond panelboard enclosure according to Section 26 05 26. Connect equipment ground bars of panels in accordance with NFPA 70.

3.3 FIELD QUALITY CONTROL

A. Perform visual and mechanical inspections listed in NETA ATS, Section 7.6.1.1.A.

B. Perform tests listed in NETA ATS, Section 7.6.1.1.B.

3.4 ADJUSTING

A. Adjust all variable trip circuit breakers to the proper setting for the load each circuit breaker is protecting. Retest to verify the setting is correct and adjust as needed. After the settings are completed, record the panel number, device number with the load trip point that the device has been adjusted for and the name and size of the load on a typed separate sheet of paper. Place one copy of this paper in the panel directory pocket and provide one copy with each operation and maintenance manual.

END OF SECTION

SECTION 262726
WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes wall switches; receptacles; multioutlet assembly; and device plates and decorative box covers.

B. Related Sections:

1. Section 26 05 33 - Raceway and Boxes for Electrical Systems: Outlet boxes for wiring devices.

1.2 REFERENCES

A. National Electrical Manufacturers Association:

1. NEMA WD 1 - General Requirements for Wiring Devices.
2. NEMA WD 6 - Wiring Devices-Dimensional Requirements.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's catalog information showing dimensions, colors, and configurations.

B. All switches, receptacles and device plates throughout project shall be from the same manufacturer unless otherwise specified.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

PART 2 - PRODUCTS

2.1 WALL SWITCHES

A. Manufacturers:

1. Pass & Seymour
2. Leviton
3. or equal

B. Product Description: Industrial Grade, NEMA WD 1, Heavy-Duty, AC only quiet toggle switch.

C. Body and Handle: Ivory thermoplastic with toggle handle red color for devices connected to emergency power system.

D. Wiring: Back and side wired. Back wiring with clamp type terminals suitable for stranded or solid wire.

E. Indicator Light: Separate pilot strap; red color lens.

F. Locator Light: Lighted handle type switch; green color handle.

G. Ratings:
   1. Voltage: 120-277 volts, AC.
   2. Current: 20 amperes.

2.2 RECEPTACLES

A. Manufacturers:
   1. Pass & Seymour
   2. Hubbell
   3. Leviton
   4. Cooper
   5. Approved equal

B. Product Description: Specification Grade, NEMA WD 1, Heavy-duty general use receptacle. Grounding system shall be all brass and integral to the wrap around mounting strap. Combination head brass grounding screw. Brass alloy triple wipe contacts shall grip both sides of plug prongs.

C. Device Body: Ivory thermoplastic. Red for devices connected to Emergency circuits. Red for devices connected to Emergency circuits.]

D. Wiring: Back and side wired. Back wiring with wrap-around steel strap clamp type terminals suitable for stranded or solid wire.

E. Configuration: NEMA WD 6, type as indicated on Drawings.

F. Convenience Receptacle: Duplex type 5-20.

G. GFCI Receptacle: Convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements.

H. Tamper Resistant Receptacle: Convenience receptacle with internal spring-loaded mechanical shutter. Type 5-20.

I. Special Purpose Receptacles: Type and rating and number of poles indicated or required for the anticipated purpose.

2.3 WALL PLATES

A. 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.

B. Weatherproof Wet Location Cover Plate: Extended polycarbonate hinged cover for use when attachment plug is inserted.

2.4 MULTIOUTLET ASSEMBLY

A. Multi-outlet Assembly: Sheet metal channel with fitted cover, suitable for use as multi-outlet assembly.

B. Size: As indicated on Drawings.

C. Receptacles: Furnish covers and accessories to accept receptacles specified in this Section.

D. Receptacles: NEMA WD 6, type 5-15R.

E. Receptacle Spacing: As indicated on Drawings.

F. Channel Finish: Gray enamel.

G. Fittings: Furnish manufacturer's standard couplings, elbows, and connectors

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify outlet boxes are installed at proper height.

B. Verify wall openings are neatly cut and completely covered by wall plates.

C. Verify branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

3.2 PREPARATION

A. Clean debris from outlet boxes.

3.3 EXISTING WORK

A. Disconnect and remove abandoned wiring devices.

B. Modify installation to maintain access to existing wiring devices to remain active.

C. Clean and repair existing wiring devices to remain or to be reinstalled.

3.4 INSTALLATION

A. Install devices plumb and level.

B. Mounting heights shown shall be measured from finished floor to the center of the outlet box.

C. Install switches with OFF position down.

D. Install all outlet boxes for light switches flush in wall where possible. Where more than one switch appears at the same location, they shall be installed in a ganged box with a single plate.

E. Where receptacles are shown adjacent to other devices, the boxes shall be installed with 2" between devices of other systems.

F. Install receptacles with grounding pole on top.

G. Connect wiring device grounding terminal to outlet box with bonding jumper and branch circuit equipment grounding conductor.

H. Install decorative plates on switch, receptacle, and blank outlets in finished areas.

I. Terminate ground wire at device where ground wire is provided within the raceway system.

J. Carefully strip thermoplastic wire to length and make-up terminal connection as recommended by the device manufacturer.

K. Secure device to outlet box with proper screws.

L. Use jumbo size plates for outlets installed in masonry walls.

M. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.

3.5 Labels and Inscriptions:

A. Identify receptacle cover plate with panel and branch circuit number (for example L2A-3). Engrave and fill with 1/8” high black letters. Red for emergency system outlets.

3.6 INTERFACE WITH OTHER PRODUCTS

A. Coordinate locations of outlet boxes provided under Section 26 05 33 to obtain mounting heights as specified and as indicated on drawings.

3.7 FIELD QUALITY CONTROL

A. Inspect each wiring device for defects.

B. Operate each wall switch with circuit energized and verify proper operation.

C. Verify each receptacle device is energized.

D. Test each receptacle device for proper polarity and grounding.

E. Test each GFCI receptacle device for proper operation.

3.8 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

3.9 CLEANING

A. Clean exposed surfaces to remove splatters and restore finish.

END OF SECTION

SECTION 262819
ENCLOSED SWITCHES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes fusible and non-fusible switches.

1.2 REFERENCES

A. National Electrical Manufacturers Association:
   1. NEMA FU 1 - Low Voltage Cartridge Fuses.
   2. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

B. International Electrical Testing Association:
   1. ANSI/NETA ATS - 2017Acceptance Testing Specifications for Electrical Power Equipment and Systems.

1.3 SUBMITTALS

A. Product Data: Submit switch ratings and enclosure dimensions.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years' experience.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCH ASSEMBLIES

A. Manufacturers:
   1. Square D.

B. Product Description: NEMA KS 1, Type HD, enclosed load interrupter knife switch. Handle lockable in OFF position.

C. Fuse clips: Designed to accommodate NEMA FU 1, Class R fuses.

D. Enclosure: NEMA KS 1, to meet conditions. Fabricate enclosure from [steel finished with manufacturer's standard gray enamel.
   1. Interior Dry Locations: Type 1.
   2. Exterior Locations: Type 3R.

E. Furnish switches with entirely copper current carrying parts.
   1. NONFUSIBLE SWITCH ASSEMBLIES

F. Manufacturers:
   1. Square D.

G. Product Description: NEMA KS 1, Type HD enclosed load interrupter knife switch. Handle lockable in OFF position.

H. Enclosure: NEMA KS 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
   1. Interior Dry Locations: Type 1.
   2. Exterior Locations: Type 3R 4X stainless steel.

I. Furnish switches with entirely copper current carrying parts.

2.2 SWITCH RATINGS

A. Switch Rating: Horsepower rated for AC or DC as indicated on Drawings.

B. Short Circuit Current Rating:
   1. Non-Fused Switches: UL listed for 10,000 rms symmetrical amperes.
   2. Fused Switches: UL listed for 10,000 rms symmetrical amperes when used with or protected by Class H or K fuses (30-600 ampere) 200,000 rms symmetrical amperes when used with or protected by Class R or Class J fuses (30-600 ampere switches employing appropriate fuse rejection schemes).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install enclosed switches plumb. Provide supports in accordance with Section 26 05 29.

B. Install fuses for fusible disconnect switches.

C. Install engraved plastic nameplates in accordance with Section 26 05 53.

D. Apply adhesive tag on inside door of each fused switch indicating NEMA fuse class and size installed.

3.2 FIELD QUALITY CONTROL

A. Provide visual and mechanical inspections per NETA ATS 7.5.1.1.A.

END OF SECTION

SECTION 262823
ENCLOSED CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes molded-case circuit breakers in individual enclosures.

1.2 REFERENCES

A. National Electrical Manufacturers Association:
   1. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.

B. International Electrical Testing Association:
   1. ANSI/NETA ATS – 2017 Acceptance Testing Specifications for Electrical Power Equipment and Systems.

1.3 SUBMITTALS

A. Product Data: Submit catalog sheets showing ratings, trip units, time current curves, dimensions, and enclosure details.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

PART 2 - PRODUCTS

2.1 MOLDED CASE CIRCUIT BREAKER

A. Manufacturers:
   1. Square D.

B. Product Description: Enclosed, molded-case circuit breaker conforming to NEMA AB 1. Circuit breakers with frame sizes 250 amperes and larger shall have a field adjustable variable magnetic trip element.

C. Minimum fully rated Short Circuit Rating:
   1. 10,000-amperes RMS at 208V, or as shown on Drawings.
   2. 35,000-amperes RMS at 480V, or as shown on Drawings.

D. Panelboard breakers shall match the kAIC rating and manufacturer of the enclosure.

E. Molded Case Circuit Breakers: NEMA AB 1, bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles, Class A ground fault interrupter circuit breakers as indicated on Drawings.
   1. Circuit breaker handle locks shall be provided for all circuits that supply emergency egress lights, energy management and control system (EMCS) panels and fire alarm panels.

2. Circuit breakers shall be molded case, thermal magnetic trip type with common trip handle for all poles.

F. Include adjustable trip breakers where required to achieve selective coordination or limit fault current as coordinated with the results of the contractor prepared power system study.

G. Accessories: As indicated on Drawings. Conform to NEMA AB 1.

H. Enclosure: NEMA AB 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.

1. Interior Dry Locations: Type 1.
2. Exterior Locations: Type 3R.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install enclosed circuit breakers plumb. Provide supports in accordance with Section 26 05 29.

B. Height: 5 feet to operating handle.

C. Locate and install engraved plastic nameplates in accordance with Section 26 05 53.

3.2 FIELD QUALITY CONTROL

A. Provide circuit breaker visual and mechanical inspection in accordance with NETA ATS, 7.6.1.1.A.

END OF SECTION

SECTION 265100
INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes interior luminaires, lamps, ballasts, and accessories.

B. Related Sections:
   1. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
   2. Section 26 05 33 - Raceway and Boxes for Electrical Systems.

1.2 REFERENCES

A. Underwriters Laboratory
   1. UL 8750-09 - Light Emitting Diode (LED) Light Sources for Use in Lighting Products.

1.3 SUBMITTALS

A. Product Data: Submit dimensions, ratings, and performance data.

B. Provide lighting fixtures complete with lamps, completely wired, controlled, and securely attached to supports.

C. Contractor shall provide entire lighting specification (including fixture catalog cuts and sketches) for each specified manufacturer with complete information about the fixtures they will supply.

D. Type of fixtures shall be as indicated alphanumerically and as specified.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

PART 2 - PRODUCTS

2.1 INTERIOR LUMINAIRES

A. Product Description: Complete interior luminaire assemblies, with features, options, and accessories as scheduled.

2.2 LED LIGHT FIXTURES

A. General:
   1. LED light fixtures shall be in accordance with IES, NFPA, UL, as shown on the drawings, and as specified.
   2. LED light fixtures shall be Reduction of Hazardous Substances (RoHS)-compliant.
   3. LED drivers shall include the following features unless otherwise indicated:
      a. Minimum efficiency: 85% at full load.

b. Minimum Operating Ambient Temperature: -20˚ C. (-4˚ F.)
c. Input Voltage: 120 - 277V (±10%) at 60 Hz.
d. Integral short circuit, open circuit, and overload protection.
e. Power Factor: ≥ 0.90.
f. Total Harmonic Distortion: ≤ 20%.
g. Comply with FCC 47 CFR Part 15.

4. LED modules shall include the following features unless otherwise indicated:
   a. Comply with IES LM-79 and LM-80 requirements.
   b. Minimum CRI 90 and color temperature 3000˚ K unless otherwise specified in LIGHTING FIXTURE SCHEDULE.
   c. Minimum Rated Life: 50,000 hours per IES L70.
   d. Light output lumens as indicated in the LIGHTING FIXTURE SCHEDULE.
5. LED lamps shall be capable of continuous dimming, without flicker or noise, from 10-100 percent.

PART 3 - EXECUTION

3.1 EXISTING WORK

A. Disconnect and remove abandoned luminaires, lamps, and accessories.

3.2 INSTALLATION

A. Provide mounting accessories as required for ceiling construction. Fixture catalog numbers do not necessarily denote specific mounting accessories for type of ceiling in which a fixture may be installed.

B. Provide adequate and sturdy support for each lighting fixture. Verify weight and mounting method of fixtures and furnish and install suitable supports. Fixture mounting assemblies shall comply with local seismic codes and regulations.

C. Install suspended luminaires using pendants supported from swivel hangers. Install pendant length required to suspend luminaire at indicated height.

D. Support luminaires independent of ceiling framing.

E. Locate recessed ceiling luminaires as indicated on Reflected Ceiling Plan.

F. Install surface mounted luminaires plumb and adjust to align with building lines and with each other. Secure to prevent movement.

G. Exposed Grid Ceilings: Support surface-mounted luminaires on grid ceiling directly from building structure.

H. Install recessed luminaires to permit removal from below.

I. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.

J. Install clips to secure recessed grid-supported luminaires in place.

K. Install wall-mounted luminaires at height as indicated on Drawings.

L. Install accessories furnished with each luminaire.

M. Connect luminaires to branch circuit outlets provided under Section 26 05 33 using flexible conduit not exceeding 6 feet.

N. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.

O. Lighting fixtures recessed in ceilings which have a fire resistive rating of 1 hour or more shall be enclosed in a box which has a fire resistive rating equal to that of the ceiling.

P. Ground and bond interior luminaires in accordance with Section 26 05 26.

3.3 FIELD QUALITY CONTROL

A. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

3.4 CLEANING

A. Remove dirt and debris from enclosures.

B. Clean photometric control surfaces as recommended by manufacturer.

C. Clean finishes and touch up damage.

END OF SECTION

SECTION 270500
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

1. For technical support and specification clarification.

B. IT project management

1. For support of network equipment installation.

C. Submittal approvals

D. Network equipment

E. Rack and Stack (UCDH in rack vendor)

F. Plug Pack Distribution (Pre-terminated switch port cabling provided and installed by the Owner)

G. Patch Cords and Patching

H. Rack Mounted PDU Power distribution Equipment (this does not pertain to the External PDU Cabinets which contain circuit breakers and supply power to the telecom rooms)

I. VOIP Router, Voice Gateway, VOIP equipment

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. Cabling test results
   1. Fiber backbone cabling.
   2. Copper backbone cabling.

I. Patch Panels
   1. RJ 45 Inserts
   2. Labels

J. Fiber Optic Housing
   1. Fiber Panels.
   2. Fiber Connectors.

K. Horizontal Wire Managers

L. Equipment Racks
   1. Two Post
   2. Four Post

M. 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.

N. Construction Clean Closet Cleaning

1.4 RELATED SECTIONS

A. 270526 GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

B. 270529 HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

C. 270533 CONDUITS AND BACKBOXES FOR COMMUNICATIONS SYSTEMS

D. 270553 IDENTIFICATIONS FOR COMMUNICATIONS SYSTEMS

E. 271116 COMMUNICATIONS CABINETS, RACKS, FRAMES, AND ENCLOSURES

F. 271119 COMMUNICATIONS TERMINATION BLOCKS AND PATCH PANELS

G. 271123 COMMUNICATIONS CABLE MANAGEMENT AND LADDER RACK

H. 271126 COMMUNICATIONS RACK MOUNTED POWER PROTECTION AND POWER STRIPS

I. 271300 COMMUNICATIONS BACKBONE CABLING

J. 271343 COMMUNICATIONS SERVICES CABLING

K. 271500 COMMUNICATIONS HORIZONATAL CABLING

1.5 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)

1.6 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

1.7 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. “Cabling”: A combination of cables, wire, cords, and connecting hardware [e.g., cables, conductor terminations, connectors, outlets, patch panels, blocks, and labeling].

F. “Identifier”: A unique code assigned to an element of the telecommunications infrastructure that links it to its corresponding record.

1.8 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.

1.9 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. All submittals including data sheets, shop drawings, and record documents shall have the project RCDD stamp/seal affixed on the cover sheet.

C. 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.

D. 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

E. 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.

F. Precede each submittal book with a summary TOC. per example schedule below:
1. Specification Section
2. Drawing Reference
3. Manufacturers Model No.

G. 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.

1.10 PRE-CUT OVER DOCUMENTS

A. Contractor shall provide record document plans indicating jack ID number, cable test reports, and cross connect matrix prior to final closeout documents.

1.11 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.

1.12 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 Warrantees 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 feet 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: CPI Motive Series full height vertical cable manager.

C. Wire Managers: CPI Motive 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 CJ6X88TGVL
   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 12'.

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 oversees 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 270526
GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes grounding and bonding of communications work, including but not limited to:
   1. Cable shields, communications racks, cabinets, and enclosures

1.2 SYSTEM DESCRIPTION

A. Provide telecommunications grounding system as described herein.

B. Except as otherwise indicated, the complete communications installation including the racks, cabinets, panels, cable tray, runway, lightning protectors cable shields and splice cases provided under the work of this project shall be completely and effectively grounded in accordance with all Code and Standards requirements, whether or not such connections are specifically shown or specified.

C. Resistance:
   1. Resistance from the farthest ground bus through the ground electrode to earth shall not exceed 5 Ohms or the requirements of ANSI-J-STD-607-D-2019, whichever is more restrictive.
   2. Resistance from Communications racks Buss ground to UFER ground must remain less than or equal to the electrical ground presented at A/C outlet for electronic equipment in the communications rack.

1.3 DEFINITIONS

A. Definitions as described in Section 270500 shall apply to this section.

1.4 RELATED SECTIONS

A. 270500 COMMON WORK RESULTS FOR COMMUNICATIONS

B. 270529 HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

C. 270533 CONDUITS AND BACKBOXES FOR COMMUNICATIONS SYSTEMS

D. 270553 IDENTIFICATIONS FOR COMMUNICATIONS SYSTEMS

E. 271116 COMMUNICATIONS CABINETS, RACKS, FRAMES, AND ENCLOSURES

F. 271119 COMMUNICATIONS TERMINATION BLOCKS AND PATCH PANELS

G. 271123 COMMUNICATIONS CABLE MANAGEMENT AND LADDER RACK

H. 271126 COMMUNICATIONS RACK MOUNTED POWER PROTECTION AND POWER STRIPS

I. 271300 COMMUNICATIONS BACKBONE CABLING

J. 271343 COMMUNICATIONS SERVICES CABLING

K. 271500 COMMUNICATIONS HORIZONTAL CABLING

1.5 QUALITY ASSURANCE

A. Comply with Quality Assurance requirements of Section 270500

B. Strictly adhere to all Telecommunications Industry Association (TIA) recommended installation practices when installing Bonding and Grounding.

C. Material and work specified herein shall comply with the applicable requirements of:
1. TIA-568-D: Commercial Building Telecommunications Wiring Standard
2. TIA-569-E: Commercial Building Standard for Telecommunications Pathways and Spaces
3. TIA-607-D: Commercial Building Grounding and Bonding Requirements for Telecommunications
4. ANSI/TIA– 606-C Administration Standard for the Telecommunications Infrastructure of Commercial Buildings

1.6 WARRANTY

A. Match warranty Section 270500

PART 2 - PRODUCTS

2.1 TELECOMMUNICATIONS GROUNDING BUSBAR (TGB)

A. The Telecommunications Grounding Bus bar provides a central ground attachment point for telecommunications bonding backbones, TR equipment, racks, cable runways, sleeves, and other system located in the Telecommunications Room. All Grounding Bus bars shall be UL listed. Hole patterns on Bus bars accommodate two-hole lugs per the recommendation of BICSI and TIA-607 standards. Insulators electrically isolate Bus bars from the wall or other mounting surfaces.

B. Manufacturer:
1. CPI Mfg. Part: 40153-12
2. Or approved equal

2.2 GROUNDING AND BONDING CONDUCTORS

A. General purpose insulated: UL listed and code sized copper conductor, with dual rated THHN/THWN, insulation color identified green.
1. Cable jacket marking:
a. Must be legible and shall contain the following information: Manufacturer's name
b. Copper conductor gauge, UL listing
c. Cable jacket shall be green with black lettering

B. Telecommunications Bonding Backbone cable:

1. 3/0 AWG THHN/THWN CU- Must be UL listed.

C. Telecommunications Bonding Conductor:
1. Sizing of the telecommunications bonding conductor per ANSIJ-STD-607-D
2. Size TBCs as the greater of 6 AWG or based on length of run using 1000CM/linear foot.

TBB/GE linear length m (ft)	TBB/GE size (AWG)
less than 4 (13)	6
4 - 6 (14 - 20)	4
6 - 8 (20 - 26)	3
8 - 10 (26 - 33)	2
10 - 13 (33 - 44)	1
13 - 16 (44 - 52)	1/0
16 - 20 (52 - 66)	2/0
20 - 26 (67 -84)	3/0
26 - 32 (85 - 105)	4/0
32 - 38 (106 - 125)	250 kcmil
38 - 46 (126 -150)	300 kcmil
46 - 53 (151 - 175)	350 kcmil
53 - 76 (176 - 250)	500 kcmil
76 - 91 (251 - 300)	600 kcmil
Greater than 91 (301)	750 kcmil

D. Manufacturers:
1. General Cable
2. Harger Lightning & Grounding
3. Or approved equal

2.3 COMPRESSION CONNECTOR LUG

A. Long-barrel compression lugs shall be used on all ground wire. Copper alloy body.
1. Provide lug size to match conductor being terminated.
2. Provide 2-hole pattern lugs.
3. Provide each lug with silicon bronze hardware, including 2 bolts, 2 split lock washers and 2 nuts.
4. UL listed.

B. Manufacturer:

1. Panduit.
2. Harger Lightning & Grounding GECLBxxx (xxx depending on cable Size).
3. Or approved equal.

PART 3 - EXECUTION

3.1 GENERAL

A. Comply with the execution requirements of Section 270500.

3.2 EXAMINATION

A. Examine existing Telecommunications Grounding Backbone system prior to the start of work within this section. The Telecommunications Contractor is solely responsible to ensure work proposed within this section is fully compatible, in the opinion of the Engineer, with the existing Telecommunications Grounding Backbone system.

3.3 CONNECTIONS TO STRUCTURAL STEEL, GROUND RODS, OR SPLICES

A. Where required by the Specifications, grounding conductors shall be spliced together, connected to ground rods, or connected to structural steel using exothermic welds or high-pressure compression type connectors.

B. Exothermic welds shall be used for cable-to-cable and cable-to-ground rod and for cable to structural steel surfaces. Exothermic weld kits shall be as manufactured by Harger Lightning & Grounding, Cadweld, Thermoweld or approved equal. Each weld shall use a kit unique to that type of weld.

C. High-pressure compression type connectors shall be used for cable-to-cable connections. Connections shall be as manufactured by Thomas & Betts #53000 series, Burndy "Hy-Ground or approved equal.

3.4 GENERAL EXECUTION

A. Provide Grounding & Bonding according to the most restrictive requirements of ANSI-J-STD-607-B, California Electrical Code Article 250, and references therein and California Electrical Code Article 800.
   1. In the event of conflicting requirements, California Electrical Code requirements shall prevail.

B. Contractor shall supply all materials required to furnish and install a complete functional telecommunications grounding system.

C. The grounding 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.

D. Point of connection:
   1. Under Work of this Section, install a complete Telecommunications Grounding System, leaving only the physical connection between the TMGB and Building Service Entrance Ground for work under Division 26 Electrical.

E. Ground bar installation
   1. The C-10 Contractor shall install a ground bar in each Telecom Room to which all ground wires, grounding terminal points within the room, and Telecommunications Bonding Backbone conductors will terminate.

F. Telecommunications Bonding Conductor:
   1. Install TBCs in a manner that will protect them from physical and mechanical damage.
   2. Routing:
      a. Route TBCs in the shortest possible path, using right-angles for turns and routed parallel to building lines.
      b. Utilize a minimum 1-foot bend radius.
   3. At TMGB/TGBs:
      a. Thoroughly clean non electro tin-plated busbar prior to fastening the conductors, bolts, or connectors to the busbar.
      b. Attach lugs to busbar with appropriate size cadmium bronze bolt, flat washer and Belle-ville washer.
   4. Torque connections.

G. Rack Bay & Overhead Cable Support Bonding
   1. Rack Bay: Bond equipment racks, frames, frame bays, cabinets, server racks, and other similar support systems located within the same room or space as the TMGB/TGB to the busbar.
   2. Overhead Cable Support:
      a. Bond overhead runway located within the same room or space as the TMGB/TGB to the busbar.
      b. Provide “grounding kit” (straps & connectors) to bond sections of cable runway for ground continuity. This requirement shall apply to sections of cable runway within a single communication room.
   3. Equipment Racks: Ground loops between equipment racks or cabinets are not permitted. Provide a single bonding conductor from each equipment rack or cabinet back to the telecom ground bus bar serving the room.

3.5 LABELING

A. General Requirements
   1. Labeling, identifier assignment, and label colors shall conform to TIA/EIA-606-A Administration Standard and as approved by Owner’s Representative before installation.
   2. Permanently label TBCs. Affix label as close as practical to each end of the conductor.

B. Label Format
   1. Labels shall be permanent with machine-generated text; handwritten labels will not be accepted.
   2. Labels on TBCs shall fully wrap around conductors with a self-laminating feature to provide permanent marking.

C. Identifier Assignment
   1. Separate label fields of the identifier with a hyphen.
   2. TBC:
      a. First field: “TBC” (the bonding conductor type).
      b. Second field: The room identity where TBC exists; for example: “B01-TDA”.
      c. Third field: A unique sequential number; for example: “01”, “02”, etc.
      d. Example: “TBC–B01-TDA–01”

3.6 RECORDS

A. Communication Bonding System records shall conform to TIA/EIA-606-C Administration Standards. Each component shall have as a minimum, the information as outlined in TIA/EIA-606-C.

3.7 ACCEPTANCE

A. Review bonding configuration after all cabling and equipment is installed for approval by project IOR representative.

END OF SECTION

SECTION 270529
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

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 270500 COMMUNICATIONS HORIZONTAL CABLING
   2. SECTION 270526 GROUNDING AND BONDING OF COMMUNICATIONS SYSTEMS
   3. SECTION 270536 CABLE TRAYS FOR COMMUNICATIONS SYSTEMS
   4. SECTION 271116 COMMUNICATIONS CABINETS RACKS FRAMES AND ENCLOSURES
   5. 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 270500

B. In additional 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 RELATED SECTIONS

A. 270500 COMMON WORK RESULTS FOR COMMUNICATIONS

B. 270526 GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

C. 270533 CONDUITS AND BACKBOXES FOR COMMUNICATIONS SYSTEMS

D. 270553 IDENTIFICATION FOR COMMUNICATIONS SYSTEMS

E. 271116 COMMUNICATIONS CABINETS, RACKS, FRAMES, AND ENCLOSURES

F. 271119 COMMUNICATIONS TERMINATION BLOCKS AND PATCH PANELS

G. 271123 COMMUNICATIONS CABLE MANAGEMENT AND LADDER RACK

H. 271126 COMMUNICATIONS RACK MOUNTED POWER PROTECTION AND POWER STRIPS

I. 271300 COMMUNICATIONS BACKBONE CABLING

J. 271343 COMMUNICATIONS SERVICES CABLING

K. 271500 COMMUNICATIONS HORIZONTAL CABLING

1.6 DEFINITIONS

A. Definitions as described in Section 270500 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 270500.

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.

END OF SECTION

SECTION 270533
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 were allowed in wall cavities and locations are accessible.

D. Provide a minimum of a 1 ¼" 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 RELATED SECTIONS

A. 270500 COMMON WORK RESULTS FOR COMMUNICATIONS

B. 270526 GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

C. 270529 HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

D. 270553 IDENTIFICATIONS FOR COMMUNICATIONS SYSTEMS

E. 271116 COMMUNICATIONS CABINETS, RACKS, FRAMES, AND ENCLOSURES

F. 271119 COMMUNICATIONS TERMINATION BLOCKS AND PATCH PANELS

G. 271123 COMMUNICATIONS CABLE MANAGEMENT AND LADDER RACK

H. 271126 COMMUNICATIONS RACK MOUNTED POWER PROTECTION AND POWER STRIPS

I. 271300 COMMUNICATIONS BACKBONE CABLING

J. 271343 COMMUNICATIONS SERVICES CABLING

K. 271500 COMMUNICATIONS HORIZONTAL CABLING

1.3 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 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:
   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. The distance between pull boxes shall not exceed 100 feet.

B. Conduits exceeding two 90-degree bends shall be upsized to the next trade size and never exceed 240 degrees.

C. Support and fasten pathway and pull boxes as defined in the electrical specifications.

D. 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.

E. 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:
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 270541
FIRE-STOPPING SYSTEMS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Section includes: Firestopping for the following.
   1. Penetrations through fire-resistance-rated floor and roof construction including both empty openings and openings containing cables, pipes, ducts, conduits, and other penetrating items.
   2. Penetrations through fire-resistance-rated walls and partitions including both empty openings and openings containing cables, pipes, ducts, conduits, and other penetrating items.
   3. Penetrations through smoke barriers and construction enclosing compartmentalized areas involving both empty openings and openings containing penetrating items.

1.2 SYSTEM PERFORMANCE REQUIREMENTS

A. Comply with California Code of Regulations - Title 24, CBC - Chapter 7, Fire Resistance Ratings and Fire Tests.

B. Test Requirements:
   1. ANSI/UL 2079 Tests for Fire Resistance of Building Joint Systems, 2020
   2. ASTM E-814 Standard Test Method for Fire Tests of Penetration Firestop Systems, 2017
   3. ANSI/UL 1479 Standard for Fire Tests of Penetration Firestops, 2015

1.3 RELATED SECTIONS

A.	270500	COMMON WORK RESULTS FOR COMMUNICATIONS
B.	270526	GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS
C.	270529	HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS
D.	270533	CONDUITS AND BACKBOXES FOR COMMUNICATIONS SYSTEMS
E.	270553	IDENTIFICATION FOR COMMUNICATIONS SYSTEMS
F.	271116	COMMUNICATIONS CABINETS, RACKS, FRAMES, AND ENCLOSURES
G.	271119	COMMUNICATIONS TERMINATION BLOCKS AND PATCH PANELS
H.	271123	COMMUNICATIONS CABLE MANAGEMENT AND LADDER RACK
I.	271126	COMMUNICATIONS RACK MOUNTED POWER PROTECTION AND POWER STRIPS
J.	271300	COMMUNICATIONS BACKBONE CABLING
K.	271343	COMMUNICATIONS SERVICES CABLING
L.	271500	COMMUNICATIONS HORIZONTAL CABLING

1.4 SUBMITTALS

A. Procedure: In accordance with Division 01 and the following:

B. Data: Manufacturer product data, including UL Listing, for all materials and prefabricated devices and manufacturer's installation instructions. Submitted material must be approved by Campus Fire Marshal prior to installation.

C. Shop drawings detailing location of installed through penetration devices.

1.5 QUALITY ASSURANCE

A. Compatibility: Provide firestop systems compatible with one another and with substrates under conditions of application and service.

B. Firestop system installation must meet requirements of ASTM E-814, UL 1479, or UL 2079 tested assemblies that provide a fire rating equal to that of construction being penetrated.

C. All materials shall be new.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with through penetration firestop systems (XHEZ) listed in Volume II of the UL Fire Resistance Directory, provide products of the following, as required by condition of use:
   1. Specified Technologies, Inc.
      Somerville, NJ, telephone 800-992-1180

2.2 MATERIALS

A. All through penetrations shall be labeled on both sides of the wall to indicate the appropriate UL system number, product used, installation date, hour rating installer, location number and telephone contact for the corresponding manufacturer. Material installed shall be as required for installation conditions and to achieve the required fire resistance.

B. Use only firestop products that have been UL 1479, ASTM E-814, or UL 2079 tested for specific fire rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire rating involved for each separate instance.

C. For penetrations by non-combustible items including steel pipe, copper pipe, rigid steel conduit and electrical metallic tubing (EMT), the following materials are acceptable:
   1. EZ-Path retrofit device sized for the conduit being installed.

D. For penetrations by combustible items (penetrants consumed by high heat aflame) including insulated metal pipe, PVC jacketed, flexible cable or cable bundles and plastic pipe (closed piping systems) the following materials are acceptable:
   1. EZ-Path Fire Rated Pathway

E. For large size/complex penetrations made to accommodate cable trays, multiple steel and copper pipes, electrical busways in raceways the following materials are acceptable:
   1. EZ-Path Fire Rated Pathway

F. Provide a firestop system with a "F" Rating as determined by UL 1479 or ASTM E-814 which is

equal to the time rating of construction being penetrated.

G. Provide a firestop system with an Assembly Rating as determined by UL 2079 which is equal to the time rating of construction being penetrated.

H. For workstation conduits from accessible ceiling to outlet.
   1. STI SpecSeal putty.

I. For pipe penetrations of cast in place concrete floors and concrete over metal decking the following material is acceptable:
   1. EZ-Path

PART 3 – EXECUTION

3.1 PREPARATION

A. Verify conditions and measurements affecting the work of this Section at site. Make sure that detrimental conditions are corrected before proceeding with installation.

3.2 INSTALLATION

A. Install materials in compliance with their manufacturer's instructions and the printed instructions of UL Fire Resistance Directory.

B. Install re-enterable, non-hardening, intumescent putty in workstation conduits where required. Do not use fire caulk.

3.3 IDENTIFICATION

A. Identify firestopping with pressure sensitive, self-adhesive preprinted labels. Attach labels permanently to surfaces of penetrated construction on both sides of each firestopping installation where the labels will be visible to anyone seeking to remove penetrating items or firestopping. Include the following information on the labels:
   1. The words: "WARNING—FIRESTOPPING—DO NOT DISTURB. NOTIFY BUILDING MANAGEMENT OF ANY DAMAGE”
   2. Contractor's name, address, and phone number
   3. Firestopping system designation of applicable testing and inspecting agency
   4. Date of installation
   5. Firestopping manufacturer's name
   6. Installer's name

END OF SECTION

SECTION 270553
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 SMBs 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.

1.4 RELATED SECTIONS

A. 270500 COMMON WORK RESULTS FOR COMMUNICATIONS

B. 270526 GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

C. 270529 HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

D. 270533 CONDUITS AND BACKBOXES FOR COMMUNICATIONS SYSTEMS

E. 271116 COMMUNICATIONS CABINETS, RACKS, FRAMES, AND ENCLOSURES

F. 271119 COMMUNICATIONS TERMINATION BLOCKS AND PATCH PANELS

G. 271123 COMMUNICATIONS CABLE MANAGEMENT AND LADDER RACK

H. 271126 COMMUNICATIONS RACK MOUNTED POWER PROTECTION AND POWER STRIPS

I. 271300 COMMUNICATIONS BACKBONE CABLING

J. 271343 COMMUNICATIONS SERVICES CABLING

K. 271500 COMMUNICATIONS HORIZONTAL CABLING

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 WORK STATION 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. 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 of label(s).

H. 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 APs 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.

I. 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.

J. 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).

K. 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.

L. Copper Riser Cabling.
1. Label all copper backbone cables of at least 25 pair constructions to contain the following information:
a. Installation Date
b. University Assigned Cable ID: (Example: 70 Tie 0P609).

M. 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 271116
COMMUNICATIONS CABINETS, RACKS, FRAMES, AND ENCLOSURES

PART 1 - GENERAL

1.1 SUMMARY

A. Equipment racks shall be Contractor furnished; Contractor installed.

B. The Owner standard is to provide 3 feet clearance from all rack and rack hardware to other hard surfaces in addition to allowing for code requirements for electrical power in the room. Some instances may require deviations due to room sizes and architectural features. Install racks according to construction documents. Report conflicts to IT before installation.

1.2 PREPARATION

A. Verify that no mechanical, electrical, or other systems and piping systems, (e.g., water sources) run through the TR Rooms or IT spaces

B. Receive approved layout from Owner IT.

C. Validate the package for the IT installation, e.g., power for equipment, pathway for cabling air conditioning and incidentals for proper operation of each TR.

1.3 EQUIPMENT MOUNTING

A. All floor supported equipment racks shall be bolted to the structure in accordance with the requirements of the CBC.

B. Contractor shall install per approved structural engineering design illustrating the materials approved that conform to these requirements.

1.4 RELATED SECTIONS

A. 270500 COMMON WORK RESULTS FOR COMMUNICATIONS

B. 270526 GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

C. 270529 HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

D. 270533 CONDUITS AND BACKBOXES FOR COMMUNICATIONS SYSTEMS

E. 270553 IDENTIFICATIONS FOR COMMUNICATIONS SYSTEMS

F. 271119 COMMUNICATIONS TERMINATION BLOCKS AND PATCH PANELS

G. 271123 COMMUNICATIONS CABLE MANAGEMENT AND LADDER RACK

H. 271126 COMMUNICATIONS RACK MOUNTED POWER PROTECTION AND POWER STRIPS

I. 271300 COMMUNICATIONS BACKBONE CABLING

J. 271343 COMMUNICATIONS SERVICES CABLING

K. 271500 COMMUNICATIONS HORIZONTAL CABLING

PART 2 - PRODUCTS

2.1 PRODUCTS

A. Equipment Racks
   1. Manufacturer – Cooper B-Line
   2. Standard Rack 7’
      a. Part Number: SB556084XU-FB
   3. Seismic Rack 7’
      a. Part Number: SB85219084-FB
   4. Standard Rack 8’
      a. Part Number: SB556096XU-FB
   5. Seismic Rack 8’
      a. Part Number: SB85219096-FB

PART 3 - EXECUTION

3.1 GENERAL

A. Free-standing Universal Racks
   1. Assemble relay racks according to manufacturer’s instructions. Verify that equipment mounting rails are sized properly for rack-mount equipment before attaching the rack to the floor.
   2. Racks and cabinets must be attached to the floor in four places using appropriate floor mounting anchors. When placed over a raised floor, threaded rods should pass through the raised floor tile and be secured in the structural floor below.
   3. Racks and cabinets shall be grounded to the TGB and or TMGB using appropriate hardware provided by the contractor. The ground will meet local code requirements and will be approved by the Authority Having Jurisdiction (AHJ).
   4. In seismic areas, the rack should have additional bracing as required by building codes and the recommendations of a licensed structural engineer.
   5. Ladder rack may be attached to the top of the rack to deliver cables to the rack. The rack should not be drilled to attach ladder rack. Use appropriate hardware from the ladder rack manufacturer.
   6. The equipment load should be evenly distributed and uniform on the rack. Place large and heavy equipment towards the bottom of the rack. Secure all equipment to the rack with equipment mounting screws.
   7. Install per approved structural requirements as defined by the project structural review.

END OF SECTION

SECTION 271119
COMMUNICATIONS TERMINATION BLOCKS AND PATCH PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install copper termination assemblies, including rack and cabinet mounted copper patch panels.

B. Furnish and install fiber termination assemblies, including:
   1. Fiber connectors
   2. Rack and cabinet mounted fiber patch panels

1.2 RELATED SECTIONS

A. 270500 COMMON WORK RESULTS FOR COMMUNICATIONS

B. 270526 GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

C. 270529 HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

D. 270533 CONDUITS AND BACKBOXES FOR COMMUNICATIONS SYSTEMS

E. 270553 IDENTIFICATIONS FOR COMMUNICATIONS SYSTEMS

F. 271116 COMMUNICATIONS CABINETS, RACKS, FRAMES, AND ENCLOSURES

G. 271123 COMMUNICATIONS CABLE MANAGEMENT AND LADDER RACK

H. 271126 COMMUNICATIONS RACK MOUNTED POWER PROTECTION AND POWER STRIPS

I. 271300 COMMUNICATIONS BACKBONE CABLING

J. 271343 COMMUNICATIONS SERVICES CABLING

K. 271500 COMMUNICATIONS HORIZONTAL CABLING

L. 275319 INTERNAL CELLULAR, PAGING, AND ANTENNA SYSTEMS

M. 271500 COMMUNICATIONS HORIZONTAL CABLING

1.3 SUBMITTALS

A. Provide product data for the following:
   1. Manufacturer’s data/cut sheets, product drawing/specifications and installation instructions for all products (submit with bid).

1.4 QUALITY ASSURANCE

A. All cable and equipment shall be installed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of the owner or owner representative.

B. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based upon the acceptable manufacturers listed. Where “approved equal” is stated or a substitution is requested, equipment shall be equivalent in every way to that of the equipment specified. All substitutions are subject to the control and approval of the owner or the owner representative.

C. Strictly adhere to all BICSI, and Telecommunications Industry Association (TIA) recommended installation practices when installing communications/data cabling.

1.5 WARRANTY

A. The horizontal communications cabling system installed shall be eligible for coverage by a Limited Lifetime Warranty to the end user.

B. Authorized Installer/Authorized Integrator shall provide labor, materials, and documentation in accordance with Panduit requirements necessary to ensure that the Owner will be furnished with a Limited Lifetime Warranty.

C. Necessary documentation for warranty registration shall be provided to the manufacturer by the installer (within 10 days) following 100 percent testing of cables.

PART 2 - PRODUCTS

2.1 COPPER CABLE TERMINATION DEVICES AND RELATED

A. Copper patch panels
   1. Rack mount category 6A 8P8C
   2. Panduit CP48WSBLY
   3. Or approved equal.

2.2 FIBER CABLE TERMINATION

A. Fiber Optic Connectors
   1. Connectors are fusion splice termination style.
   2. Provide fusion splice to factory assembly including fiber pig tail & connector
   3. Insertion loss for multi-mode ≤ 0.03 dB - manufacturer’s rating for typical splice.
   4. Insertion loss for single mode ≤ 0.06 dB - manufacturer’s rating for typical splice.
   5. LC at rack mounted patch panels as noted or scheduled,
   6. Use Corning Cable Systems model X77 Micro Fusion Splicer, Fujikura fusion splicer, or equal.

B. Utilize a precision zirconia ceramic ferrule.

C. Shall have a radial-ramped coupling nut, which facilitates mating/de-mating.

D. Connector performance per TIA-568. C.3 and the following:
   1. Insertion Loss, multimode: Less than or equal to 0.75 dB per mated pair.
   2. Insertion Loss, single mode: Less than or equal to 0.50 dB per mated pair
   3. Insertion Loss: single mode, angle polish: Less than or equal to 0.30 dB per mated pair
   4. Return Loss: single mode, Ultra Polish, greater than or equal to 55 dB
   5. Return Loss: single mode, Angle Polish, greater than or equal to 65 dB

E. Fusion Spliced LC Multimode matching to the fiber type being terminated.

F. Fusion Spliced LC Single Mode matching the fiber type being terminated.

2.3 FIBER DISTRIBUTION PANELS

A. Fiber Termination Unit
   1. AFL rack mounted fiber housing with LC connector panels sized accordingly.
   2. Provide manufacturer's blank cover inserts at unused openings.

PART 3 - EXECUTION

3.1 GENERAL

A. The contractor selected to provide the installation of this system shall be certified by the manufacturing company in all aspects of design, installation and testing of the products described herein.

B. Contractor shall have a minimum of five (5) years of recent experience on structured cabling systems of similar type, size, and quantities.

C. Cable termination:
   1. Route cables in Telecom Rooms to patch panels in racks by routing across cable runway to top of rack and then down vertical cable management sections to back of patch panels or termination locations.
   2. Route cables in Telecom Rooms to wall mount cabinets and down through openings of top and/or bottom of cabinets to patch panels. Cabinet standoffs may be used to create additional and necessary pathway.
   3. Cables and Termination Hardware: Test 100 percent for defects in installation and verify cabling system performance under installed conditions.
      a. Verify all pairs of each installed cable before system acceptance.
      b. Defects in cabling system installation, including but not limited to cables, connectors, patch panels, and connector blocks shall be repaired or replaced to ensure 100 percent useable conductors in all cables installed.
   4. Cables, Jacks, Connecting Blocks, and Patch Panels:
      a. Verify all pairs of each installed cable before system acceptance.
      b. Defects in cabling system installation, including but not limited to cables, connectors, patch panels, and connector blocks shall be repaired or replaced to ensure 100 percent useable conductors in all cables installed.

END OF SECTION

SECTION 271123
COMMUNICATIONS CABLE MANAGEMENT AND LADDER RACK

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes provision of cable management for cabling installed under the work of this Project.

B. Install plywood to surround each TR room to support systems and cable management.

C. Install ladder racking.

D. Install Owner provided racks and vertical wire managers to support cable management and supporting systems within the room.

E. Contractor to furnish and install patch panels.

F. Contractor to furnish and horizontal cable management.

G. Install conduit, fire penetrations, and cable pathway suitable to support and manage the installation of fiber and copper data infrastructure per BICSI standards.

H. Ensure proper maximum fill ratios for all pathways. Do not overfill pathways.

I. Ensure proper EMI separation.

J. Install innerduct where required.

1.2 RELATED SECTIONS

A. 270500 COMMON WORK RESULTS FOR COMMUNICATIONS

B. 270526 GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

C. 270529 HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

D. 270533 CONDUITS AND BACKBOXES FOR COMMUNICATIONS SYSTEMS

E. 270553 IDENTIFICATIONS FOR COMMUNICATIONS SYSTEMS

F. 271116 COMMUNICATIONS CABINETS, RACKS, FRAMES, AND ENCLOSURES

G. 271119 COMMUNICATIONS TERMINATION BLOCKS AND PATCH PANELS

H. 271126 COMMUNICATIONS RACK MOUNTED POWER PROTECTION AND POWER STRIPS

I. 271300 COMMUNICATIONS BACKBONE CABLING

J. 271343 COMMUNICATIONS SERVICES CABLING

K. 271500 COMMUNICATIONS HORIZONTAL CABLING

PART 2 - PRODUCTS

2.1 BACKBOARD CABLE MANAGEMENT (CONTRACTOR FURNISHED AND INSTALLED)

A. ¾ inch x 48" x 84 "A/C grade, fire rated, painted plywood installed on perimeter of the room.
   1. Plywood will be painted with an approved fire-retardant paint compliant with APWA and CSFM/CBC standards.
   2. Fire rating labels on plywood will be covered with masking tape before painting and later removed to allow for inspection before turnover.

2.2 INNERDUCT (CONTRACTOR FURNISHED AND INSTALLED)

A. Interior (non-plenum)
   1. Carlon Optic-Gard/PVC.
   2. Arnco.

B. Interior (plenum)
   1. Carlon Plenum-Gard.
   2. Arnco.

2.3 CONDUIT SPILLWAY (CONTRACTOR FURNISHED AND INSTALLED)

A. For conduit transitions.

B. Constructed of fire-retardant ABS.
   1. Panduit CWF400 or equal.

2.4 CABLE TRAY WATERFALL (CONTRACTOR FURNISHED AND INSTALLED)

A. Provide cable tray waterfall or drop out at ends of all runs.
   1. Cooper B-line 9A-1104.
   2. Cooper B-line 99-1124.
   3. Or approved equal.

2.5 CABLE TRAY TRANSITIONS (CONTRACTOR FURNISHED AND INSTALLED)

A. All turns, bends, and direction changes shall use manufacturer's pre-manufactured materials.

B. Vented trough engineered rounded transitions such as Cooper B-line 4AVT-12-90-HB-24 shall be accepted.

2.6 CABLE TRAY DIVIDER (CONTRACTOR FURNISHED AND INSTALLED)

A. Provide where separation is required between conductors routed in the same tray.
   1. 73A-90HBFL.

2. Or approved equal.

2.7 BASKET TRAY WATERFALL (CONTRACTOR FURNISHED AND INSTALLED)

A. Provide cable tray water fall at all trays ends and side cuts.

B. Provide drop out at center cuts.
1. Panduit WGBTMWFBL.
2. Panduit WGSDWWF4BL.
3. B-line WB06-DO (8 or 12).

2.8 BASKET TRAY RAIL RISER (CONTRACTOR FURNISHED AND INSTALLED)

A. WB2RR or equal.

2.9 BASKET TRAY DIVIDER (CONTRACTOR FURNISHED AND INSTALLED)

A. WB2B-3M or equal.

2.10 J HOOK CABLE MANAGEMENT (CONTRACTOR FURNISHED AND INSTALLED)

A. Provide and install according to Section 27 05 29.

2.11 HORIZONTAL WIRE MANAGER (CONTRACTOR FURNISHED AND INSTALLED)

A. Install 2 or 4 RU assembly as indicated in Owner provided rack elevations.

B. Panduit NM2 or NMF4 as shown on IT rack elevation drawings.

2.12 VERTICAL WIRE MANAGEMENT (CONTRACTOR FURNISHED AND CONTRACTOR INSTALLED)

A. High density vertical wire manager to accommodate fiber and copper cross connecting patching cables in addition to providing power distribution power strip mounting surfaces and space.

B. Vertical Wire Manager Manufacturer: CPI
1. 6” Wide x 7’ Tall Model: Motive 32620-703
2. 8” Wide x 7’ Tall Model: Motive 32621-703
3. 10” Wide x 7’ Tall Model: Motive 32622-703
4. 12” Wide x 7’ Tall Model: Motive 32623-703
5. 6” Wide x 8’ Tall Model: Motive 32620-715
6. 8” Wide x 8’ Tall Model: Motive 32621-715
7. 10” Wide x 8’ Tall Model: Motive 32622-715
8. 12” Wide x 8’ Tall Model: Motive 32623-715

C. Dual PDU Bracket

1. CPI 32601-XOO

D. Half Spool Kit

1. CPI 32651-001

E. Install according to construction documents.

PART 3 - EXECUTION

3.1 GENERAL EXECUTION - PREPARATION

A. OWNER IT is responsible for preliminary layout of the telecommunications room and shall provide requirements to Construction Team for the production of shop drawings.

B. The cabling contractor in addition to the engineer is responsible for managing cable quantities and validation of the pathways provided for fill ratio and placement to ensure cable length and capacities are according to Owner requirements. If a determination is made that the pathway is deficient, the contractor shall construct additional pathways accordingly.

C. Install products, components, accessories, hardware, etc., according to the manufacturer's instructions.

D. The contractor selected to provide the installation of this system shall be certified by the manufacturing company in all aspects of design, installation and testing of the products described herein.

3.2 PATHWAY CABLE MANAGEMENT

A. Provide a comprehensive cable management system complete with all accessories including radius corners at vertical and horizontal bends, section splice plates, expansion plates, blind-end plates, etc.

B. Cable Tray/Basket Tray Cable Management
1. Do NOT Tie Wrap cables.
2. Do NOT Secure cables to cable tray unless required to hold in place.
   a. Cable shall not be attached to the cable tray (i.e., cable shall be left "loose")
3. For performance reasons, station cabling in tray shall not be combed.
4. Cable shall be laid in tray or ladder rack in such a way as to present a neat and professional appearance.

C. Ladder Rack Cable Management
1. Do NOT Tie Wrap cables.
2. Do NOT Secure cables to cable tray unless required to hold in place.
   a. Cable shall not be attached to the cable tray (i.e., cable shall be left "loose").
3. For performance reasons, station cabling in tray shall not be combed.
4. Cable shall be laid in tray or ladder rack in such a way as to present a neat and professional appearance.

D. J HOOK Cable Management
1. Cables are to be consistently grouped together with like systems cabling (Fiber/AV/ Copper/Feeder, Etc.

2. Suspended cable runs (J-Hooks) shall be supported at intervals not exceeding every 5'. Cable installed on exposed surfaces or structural members shall be installed parallel and perpendicular to the surfaces unless a cable distance limitation arises. Cable distance and remaining within cable distance limits shall take priority. Surface contours shall be followed wherever possible.
3. Attaching cables to pipes, electrical conduit, mechanical items, existing cables, or the ceiling support system (grids, hanger wires, etc. – with the exception of ceiling support anchors) is not acceptable unless approved by the AHJ
4. Cabling installed in J-Hooks or Stiffy's, shall not have a deflection of more than 3", as identified in the cable support details, in the drawings.

3.3 EXAMINATION AND ACCEPTANCE

A. Perform walk thru with Owner representative to validate cable separation, cable routes and fill ratios.

END OF SECTION

SECTION 271126
COMMUNICATIONS RACK MOUNTED POWER PROTECTION AND POWER STRIPS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Building IT UPS. Three phases.
   1. All IT equipment in the IT room shall be serviced (unless prohibited by code) by the IT UPS vendor. A single efficient building UPS is the goal of IT to minimize UPS size and optimize maintenance. (Owner Furnished, Owner Installed)

B. Centralized IT UPS systems larger than 10 KVA, or three phase unit (Contractor Furnished Contractor Installed). Refer to Electrical Plans for additional information.

C. Power provided to the IT UPS system, contractor furnished, and contractor installed.

D. Power Distribution from IT UPS power distribution panel to each outlet, Contractor Furnished and Contractor Installed.

E. Turn up, test and certification provided by Contractor.

F. Installation of Power Strips in Cabinets and Racks are Owner Furnished and Installed by Owner In-Rack Vendor.

1.2 REFERENCES

A. ANSI/TIA-569-E Telecommunications Pathways and Spaces, 2019

B. ANSI/TIA-568.0-D Generic Telecommunications Cabling for Customer Premises, 2015

C. ANSI/TIA – 568.1-D Commercial Building Telecommunications Cabling Standard, 2015.

D. ANSI/TIA-942-B Telecommunications Infrastructure Standard for Data Centers, 2017.

E. ANSI/TIA – 606-C Administration Standard for Telecommunications Infrastructure, 2017.

F. ANSI/TIA – 607-D Generic Telecommunications Bonding and Grounding (Earthing) For Customer Premises, 2019.

G. ANSI/TIA-862-B Structured Cabling Infrastructure Standard for Intelligent Building Systems, 2016

H. California Electrical Code (CEC).

1.3 SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for rack-mounted power protection and power strips.
   2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For communications equipment room fittings. Include plans, elevations, sections, details, and attachments to other work.
   1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   2. Include workspace requirements and access for cable connections.
   3. Grounding: Indicate any chassis bonding requirements.
   4. Network Connection and Programming: Indicate networking and configuration requirements and connections.

1.4 QUALITY ASSURANCE

A. Product Certifications: UL & cUL 62368; IEC 62368; CE; FCC Part 15, Class A; EN 55022 and RoHS Compliant

1.5 RELATED SECTIONS

A. 270500 COMMON WORK RESULTS FOR COMMUNICATIONS

B. 270526 GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

C. 270529 HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

D. 270533 CONDUITS AND BACKBOXES FOR COMMUNICATIONS SYSTEMS

E. 270553 IDENTIFICATIONS FOR COMMUNICATIONS SYSTEMS

F. 271116 COMMUNICATIONS CABINETS, RACKS, FRAMES, AND ENCLOSURES

G. 271119 COMMUNICATIONS TERMINATION BLOCKS AND PATCH PANELS

H. 271123 COMMUNICATIONS CABLE MANAGEMENT AND LADDER RACK

I. 271300 COMMUNICATIONS BACKBONE CABLING

J. 271343 COMMUNICATIONS SERVICES CABLING

K. 271500 COMMUNICATIONS HORIZONTAL CABLING

1.6 SEQUENCING

A. Coordinate with Construction management and Owner representative. A 30-Day burn in is required for electronic equipment.

1.7 PREPARATION

A. Verify that no piping systems, (e.g., water sources) run through or above the UPS location.

B. Provide shop drawings indicating locations and sizes of UPS systems to receive approval of IT Facilities.

1.8 EMERGENCY POWER

A. Provide two (2) separate emergency distribution systems from two (2) ATS designed “Life Safety System” and “Equipment System” where available.

1.9 POWER NON-HOSPITAL (LEASED ADMIN)

A. Provide two (2) separate distribution systems from two diverse panels.

B. Where available backup generator service shall provide service to UPS equipment.

C. Owner required emergency power loads such as IT systems shall be placed on the “Equipment System” (Load shedding provisions).

PART 2 - PRODUCTS

2.1 UNINTERRUPTABLE POWER SUPPLIES

A. Liebert UPS

2.2 GENERAL

A. A bypass circuit shall be provided as an integral part of the UPS. The bypass control logic shall contain an automatic transfer control circuit that senses the status of the inverter logic signals and operating and alarms conditions. This control circuit shall provide a transfer of the load to the bypass source if available and if the inverter is capable of powering the load (i.e., if there is an overload condition, if the unit is in Manual Bypass Mode or if the voltage or frequency is out of tolerance).
   1. Automatic Transfers

2.3 BYPASS

A. The transfer control logic shall activate the bypass automatically, transferring the critical AC load to the bypass source, shall be provided when applicable.

B. **COMMUNICATION OPTIONS**
   1. Liebert IntelliSlot Communications

C. The UPS shall include one Liebert IntelliSlot communication port to allow the operator to field-install an optional Liebert IntelliSlot communication card. A Liebert IntelliSlot card may be installed during any state of UPS operation (On, Standby or Off states). Available Liebert IntelliSlot options are described below.

D. Liebert IntelliSlot Web Card (IS-WEBCARD)

E. The optional Liebert IntelliSlot Web Card shall deliver SNMP and Web management to the UPS when connected to any 10 or 100 Mbit Ethernet network. The card shall support 10 and 100 Mbit Ethernet and shall provide for in-the-field upgrade of SNMP firmware. The kit shall include the Liebert IntelliSlot card, MIB, configuration cable and user manual.

F. Liebert IntelliSlot Relay Interface Card (RELAYCARD-INT)

G. The optional Liebert IntelliSlot Relay Interface Card shall provide contact closure for remote monitoring of alarm conditions in the UPS, delivering signals for On Battery, On Bypass, Low Battery, Summary Alarm, UPS Fault and on UPS. The contacts shall be rated for 24VAC or 24VDC at 1A. Connections shall be to a DB25F connector with cable provided by the end user.

2.4 ANY-MODE SHUTDOWN

A. The purpose of Any-Mode Shutdown shall be to shut down the UPS output by turning off the rectifier, inverter, and bypass so that there is no power to the loads.

B. Any-Mode Shutdown can be operated locally and remotely, as described as follows:

C. Local Any-Mode Shutdown can be performed by shorting Pin 1 and Pin 2

D. Remote Any-Mode Shutdown can be performed by a switch connected to Pin 1 and Pin 2 and mounted at a remote location.

E. Remote Power Off shall be performed either by NO or NC contact of Any-Mode Shutdown, depending on the settings in the configuration program.

F. A current-limited source (+12VDC, 50mA) shall be available from the UPS.

G. The connection to the UPS for remote connection shall be via terminal block connector.

H. Any-Mode Shutdown wiring shall conform to all national, regional, and local wiring regulations.

2.5 BATTERY MODE SHUTDOWN

A. Battery Mode Shutdown shall permit shutting down the UPS by turning Off the rectifier, inverter, and bypass so that there is no power to the load when the UPS is On Battery. Battery Mode Shutdown can be performed locally or remotely:

B. Local Any-Mode Shutdown can be performed by shorting Pin 3 and Pin 4.

C. Remote Any-Mode Shutdown can be achieved by a switch connected to Pin 3 and Pin 4 and mounted at a remote location.

D. On Battery

E. On Battery signal shall be a normally open (NO) dry contact. When the UPS is supplying output power from the battery this dry contact shall be closed.

F. Low Battery

G. Low Battery signal shall be a normally open (NO) dry contact. When the UPS is supplying output power from the battery and has reached the Low Battery Warning time selected in the configuration program, this dry contact shall be closed.

H. The rated values for the dry contacts shall be:

I. Rated Voltage: 5V

J. Working Voltage Range: 4.5-10V

K. Rated Current: 30Ma

2.6 LIEBERT REMOTE SYSTEMS MONITORING

A. All UPS systems must integrate into the existing UPS remove monitoring system to be approved for installation.

2.7 WARRANTIES

A. Minimum of 3 years of standard warranty with ability to extend by at least 2 additional years. Advanced replacement of defective equipment shall be offered as a standard service.

PART 3 - EXECUTION

3.1 GENERAL

A. Confirm the exact power output distribution requirements with the Owner's Representative.

B. Estimated runtime of 30 minutes is required. Provide Quantity (2) Two Optional External Battery Cabinets in base bid. Check with Owner’s Representative for additional requirements.

C. Secure approval of UPS locations with IT Facilities.

D. Confirm the location of Power Strips with the Owner's Representative. (1) One Power Strip per Vertical Wire Manager is required.
1. Three Rack Layout requires (4) Four Vertical Power Strips, (1) One Horizontal Power Strip
2. Four Rack Layout requires (5) Five Vertical Power Strips, (2) Two Horizontal Power Strips

E. Input Disconnect
1. Install disconnect to input of UPS applicable to the size and type of appliance.
2. 10 KVA UPS installations shall have a wall mounted disconnect (EPO) within the IT Equipment room.
3. 6 KVA UPS installations shall have a wall mounted disconnect (EPO) within the IT Equipment room.
4. 3 KVA Disconnect or EPO is provided within the UPS itself.

F. Demonstration
1. Full functionality of UPS by:
   a. Disconnecting power to the UPS and demonstrating ability of UPS to carry load consistent with the manufacturers’ runtime for the attached load.
   b. Demonstrate that the UPS passes the manufacturers diagnostic software with no errors.

END OF SECTION

SECTION 271300

COMMUNICATIONS BACKBONE CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. The Section applies to all new TR rooms within the project. Work of this Section includes:

1. Indoor Copper Backbone Cabling between Telecommunications Rooms.
2. Indoor Copper Backbone Cabling between Telecommunications Rooms and MPOE.
3. Indoor Optical Fiber Backbone Cabling between Telecommunications Rooms.

1.2 SYSTEM DESCRIPTION

A. High-capacity infrastructure required to support aggregated voice and data communications to areas outside the immediate influence of the local TR Room.

B. Communications Back Bone typically consisting of:

1. Category 3 Voice Grade Copper Communications Infrastructure Backbone
2. Optical Fiber Transport Medium(s) Infrastructure Backbone

C. This section may describe configurations for cabling associate with the Owner Medical Center Campus. Offsite configuration may require circuit extensions and single entrances not described in the specification. Report conflicts between construction drawings and IT standard to the Owner representative before purchasing material or proceeding with installation.

1.3 RELATED SECTIONS

A. 270500 COMMON WORK RESULTS FOR COMMUNICATIONS

B. 270526 GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

C. 270529 HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

D. 270533 CONDUITS AND BACKBOXES FOR COMMUNICATIONS SYSTEMS

E. 270553 IDENTIFICATIONS FOR COMMUNICATIONS SYSTEMS

F. 271116 COMMUNICATIONS CABINETS, RACKS, FRAMES, AND ENCLOSURES

G. 271119 COMMUNICATIONS TERMINATION BLOCKS AND PATCH PANELS

H. 271123 COMMUNICATIONS CABLE MANAGEMENT AND LADDER RACK

I. 271126 COMMUNICATIONS RACK MOUNTED POWER PROTECTION AND POWER STRIPS

J. 271343 COMMUNICATIONS SERVICES CABLING

K. 271500 COMMUNICATIONS HORIZONATAL CABLING

1.4 SUBMITTALS

A. Provide submittal information for the following submittal sections as described below:

1. Product Data
2. Shop Drawings:
    a. Cable routing and Grouping Plan.
    b. Front of Rack elevations showing completed as-built corrections.
    c. Provide as-built records of equipment cabinet/rack with addressing and labeling scheme.
    d. Provide as-built fiber strand, adapter panel, and FDU and WME housing addressing, and labeling scheme as installed.

PART 2 - PRODUCTS

2.1 FIBER OPTIC COMMUNICATIONS CABLING

A. Fiber Optic Cable, Inside Distribution, Breakout Cable

1. Manufacturer: General Cable
    a. Part Number: BEXXX1PNU-ILPA
    b. Part Number: APXXX1PNU-ILPA
    c. Refer to plans for Strand Count: (where “XXX” equals strand count)
2. Or pre-approved equal.

B. Fiber Optic Cable, Plenum

1. General Cable
    a. Part Number: BEXXX1PNU-ILPA
    b. Part Number: APXXX1PNU-ILPA
    c. Refer to plans for Strand Count. (where XXX equals strand count)
2. Or pre-approved equal.

PART 3 - EXECUTION

3.1 GENERAL

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 Owner.

B. Installation shall be performed and accomplished in a professional manner, by qualified personnel.

3.2 PERFORMANCE STANDARDS

A. Fiber Optic Cabling

1. The optical loss budget for any end-to-end link not to exceed the sum of (optical fiber loss + splice loss + connector loss).

2. Optical fiber loss shall be the optical fiber specified cable performance, pro-rated for total link distance.

3. Fiber loss, multimode, not to exceed:

   a. At 850 nanometers, 3.5 dB per kilometer; at 1300 nanometers, 1.5 dB per kilometer.

4. Fiber loss, single mode, outside plant cable, not to exceed:

   a. At 1310 nanometers, 0.5 dB per kilometer; at 1550 nanometers, 0.5 dB per kilometer.

5. Fiber loss, single mode, inside plant cable, not to exceed:

   a. At 1310 nanometers, 1.0 dB per kilometer; at 1550 nanometers, 1.0 dB per kilometer.

6. Splice loss, multimode not to exceed 0.15 dB for each fusion splice.

7. Splice loss, single mode not to exceed 0.06 dB for each fusion splice.

8. Connector loss, multimode not to exceed 0.75 dB for each mated pair of type lc, ultra-polish connector.

9. Connector loss, single mode not to exceed 0.60 dB for each mated pair of type lc, ultra-polish connector or 0.30 dB for each mated pair of type lc, angle polished connector.

3.3 INSTALLATION

A. FIBER OPTIC CABLING

1. Minimum Interconnectivity between MPOE and all TRs shall be 24 strand SM fiber, to each TR.

2. Interconnectivity from the secondary EF to all other TR's shall be 24 strand SM fiber, to each TR.

3. Diverse physical pathway shall be determined between telecommunications rooms that precludes using a single physical pathway for all backbone cabling between TR's.

4. At TR / MPOE and EFs, at both ends of cables, wrap the room before entering patch panel by a dressed route.

5. At interior: Provide splice free cabling between telecom rooms; as well as between telecom rooms and all locations in the same building indicated for fiber cabling media.

6. Terminate fibers using a pre-terminated LC connector were indicated by Owner Representative.

7. Review proposed breakout procedure with the Owner's Representative before beginning this work.

8. Refer to OWNER IT elevations and distribution drawings for further details.

3.4 TESTING

A. GENERAL

1. Test and report on each intermediate cabling segment separately, including station cabling, horizontal distribution (each segment, if multiple) and telecommunications room wiring.

2. Test each end-to-end cable link.

3. Submit machine-generated documentation and raw data of all test results on Contractor-provided, and Owner's representative approved, forms; and in electronic format approved by the Owner's Representative.

3.5 TEST PROCEDURES – COPPER

1. A new cable shall be tested only after all wires within the cable have been terminated at both ends.

2. The Contractor shall test all high-count copper cables and submit test result information in an electronic format. Acceptable formats are Word, Excel. Owner's representative to provide required format for test report documentation.

3. TEST #1 – Continuity: Use multi-meter capable of reading resistance.

4. Meter set for 20-ohm full scale ohm reading. Each pair shall be shorted at one end and the loop resistance value read at the other.

5. The difference between the largest and the smallest resistance reading from each pair in the cable shall be no more than 10 percent of the largest reading.

6. The Contractor shall correct all defects possible.

7. If the maximum number of unrepairable defective pairs exceeds 1% of the cable's pair count, the cable shall be deemed unacceptable and shall be replaced. Replace, re-terminate and retest new cable at no additional cost to the Owner.

8. Comply with the detailed reporting results described above and the following: high pair count copper cables.

9. Submit Test Report. Documentation shall include loop resistance regarding any opens, shorts, transpositions found, as well as corrective action taken to correct any found opens, shorts, or transpositions.

3.6 TEST PROCEDURES – FIBER

A. Testing

1. The Contractor shall test all fiber optic cables and submit all fiber test result data in electronic format.

2. Perform fiber optic cable testing on all installed fiber optic cabling. Submit test results. Notify Owner's representative in writing at least 72 hours in advance that fiber optic cable testing shall commence. Submit calibration certification for testing equipment to be used.

3. A new cable shall be tested only after all wires within the cable have been terminated at both ends unless specifically requested by the Owner.

4. Fibers tests shall include OTDR, results with the meter set to the wavelength measurements specific to the cable or as requested by IT.

5. A second set of testing shall be power meter for the same strands

6. OTDR Distance and Attenuation Assessments perform on all cabling segments perform in accordance with the requirements of: TIA-568-C.1, TIA-568-C.3, TIA-455-59-A.

7. Test all fibers with launch and far end cable of sufficient length for the OTDR to be able transmit through all installed connectors.

8. OTDR through all connectors, a one-way test is not acceptable. Means and methods to fully evaluate product installed shall be approved prior to commencing.

9. Test and submit strip charts and/or tracer recordings on all strands in each tube in every cable in both directions.

10. User Interface records including a graph depicting fiber loss locations and total DB loss per event via OTDR.

11. Submit test report no later than five days after the cables are tested.

B. Test and submit OTDR attenuation assessments test results on each fiber, in each cable, and in both directions under final installation conditions. Submit with the following information:

1. Date of test

2. Name of test personnel

3. Test wavelength

4. Pulse duration(s) and scale range(s)

5. Index of refraction

6. Fiber cable type and part number

7. Fiber tube and/or fiber strand number

8. Direction of test

9. Overall distance

10. Attenuation in dB

11. Localized attenuation shall not exceed 0.5 dB at any point

3.7 TEST EQUIPMENT

A. Contractor shall provide all test equipment as required to perform the scope of work.

B. Test the communication systems cabling using at least one (1) each of the following test measurement devices or their functional equivalents:

1. Level III field testers as defined in TIA-1152 – Fluke DSX-5000, or equal.

2. The tester including the appropriate interface adapter must meet the specified accuracy requirements.

3. The accuracy requirements for the permanent link test configuration (baseline accuracy plus adapter contribution) are specified in Table 4 of TIA-1152.

4. The RJ45 test plug shall fall within the values specified in TIA-568-C Annex C for NEXT, FEXT and Return Loss.

5. 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.

6. 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. The contractor shall provide proof that the interface has been calibrated within the period recommended by the vendor.

7. 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.

8. Outside Plant Voice Cabling Plant tester - capable of detecting shorts, opens, reversals, mis-wiring and cross twists.

    a. Siemon STM-8, Fluke or equal.

C. Optical Power Meter - Multimode

1. Corning Cable Systems, Fluke or equal

2. Minimum Performance - Multimode Power Meter 850nm and 1300nm +/- 20 nm wavelength LED light sources.

3. Spectral width of sources shall be </= 50nm for 850nm wavelengths and </= 140nm for 1300nm wavelengths.

4. Output Stability +/- 0.40 dB from 0 to 50 degrees C

5. Long Term output stability +/- 0.10dB at 25 degrees C Connector types to include: LC only.

D. Optical Power Meter – Single Mode

1. Corning Cable Systems, Fluke or equal
2. Minimum Performance - Single Mode Power Meter 1300nm and 1500nm +/- 20 nm wavelength laser light sources.
3. Output Stability +/- 0.40 dB from 0 to 50 degrees C
4. Long Term output stability +/- 0.10dB at 25 degrees C Measurement range shall be from 10 to -60 dBm
5. Accuracy shall be +/- 5% at 0 to -50dBm and +/- 10% 10 to 0dBm and -50 to-60 dBm.
6. Resolution shall be 0.1 dB
7. Connector types shall include LC only.
8. Optical Time Domain Reflectometer. (Fluke, JDSU or equal).

3.8 EXAMINATION & ACCEPTANCE

A. Testing Results Review and Verification by the Owner

1. Contractor shall submit (1) copy of software capable of viewing the electronic test result files.
2. Data found to be altered from the manufacturers recommended settings may result in retention by the Owner of a 3rd party test company to retest the installed cabling at the expense of the Contractor.
3. Events exceeding industry standards will cause the test result to be rejected. Direct review by
4. Owner IT will be required to allow for an exception of a test result.
5. Data found to be incomplete may result in retention by the Owner of a 3rd Party Test Company to retest the installed cabling at the expense of the Contractor.

3.9 FINAL REVIEW

1. Walk each route defined in preparation section and describe the diverse and redundant routes taken for each and all backbone cables.
2. Produce documentation and illustrate during walk thru the labeling completed.
3. Provide UL listings and display conformance to all Fire ratings and UL listings between all locations. Provide signed inspections reports depicting authority having jurisdiction approval of all work completed.

END OF SECTION

SECTION 271343
COMMUNICATIONS SERVICES CABLING

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Outdoor (Outside Plant) Communications Cabling placed underground in existing communications ducts.
   1. High pair count copper cabling
   2. Fiber Optic Cabling
   3. Terminate fiber on patch panels as specified in Section 271119
   4. Terminate copper cabling on lightning protectors as specified in Section 270500

B. For all cabling
   1. Test cabling to demonstrate performance to specified standards or better using test equipment and methods as specified in Section 270500.
   2. Label cables, jacks, plates, and patch panels as specified in Section 270553.
   3. Document on Record Documents as described in Section 270500.

1.2 RELATED SECTIONS

A. 270500 COMMON WORK RESULTS FOR COMMUNICATIONS

B. 270526 GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

C. 270529 HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

D. 270533 CONDUITS AND BACKBOXES FOR COMMUNICATIONS SYSTEMS

E. 270536 CABLE TRAYS FOR COMMUNICATIONS SYSTEMS

F. 270553 IDENTIFICATIONS FOR COMMUNICATIONS SYSTEMS

G. 271116 COMMUNICATIONS CABINETS, RACKS, FRAMES, AND ENCLOSURES

H. 271119 COMMUNICATIONS TERMINATION BLOCKS AND PATCH PANELS

I. 271123 COMMUNICATIONS CABLE MANAGEMENT AND LADDER RACK

J. 271126 COMMUNICATIONS RACK MOUNTED POWER PROTECTION AND POWER STRIPS

K. 271300 COMMUNICATIONS BACKBONE CABLING

L. 271500 COMMUNICATIONS HORIZONTAL CABLING

1.3 REFERENCES

A. In addition to the requirements of Section 270500 - Common Work Results for Communications, conform to the applicable portions of the following standards agencies:
   1. BICSI
   2. Customer Owned Outside Plant Design Manual, Latest Edition.
   3. Conform with the requirements of Section 270500 - Common Work Results for Communications

1.4 SUBMITTALS

A. All submittals shall be approved by IT Facilities.

1.5 SEQUENCING

A. Complete entrance facilities prior to need for communications to fire life safety.

B. Complete Section 271300 to facilitate need for communications to fire life safety.

PART 2 - PRODUCTS

2.1 FIBER OPTIC CABLING

A. As specified in Section 270050 – Common Work Results for Communications

B. Fiber Optic Cable, Outside Plant:
   1. AFL
   2. Corning
   3. Approved Equal

C. Drawing References:
   1. F-XXX Multimode, where XX indicates fiber count.
   2. F-XXX Single mode, where XX indicates fiber count.
   3. Contact Owner Representative for next sequenced designation number.
   4. Contact Owner Representative for underground plant MAP.

D. Refer additionally to Fiber Cable Construction, General, and elsewhere herein.
   1. Adhere to TIA-455 or TIA-568c.3 or applicable.

E. Suitable and approved for wet location/direct burial.

F. Loose Tube, Gel Filled Construction
   1. Armored/rodent resistant construction.
   2. Jacket:
      a. Polyethylene, polyurethane, or PVC.
   3. 0.040" minimum thickness.

G. Performance:
   1. Maximum attenuation per EIA/TIA-455-61
   2. Multimode

3. 850 nm: ≤ 3.5 dB/km
4. 1300 nm: ≤ 1.0 dB/km
5. Single mode
6. 1300 nm: ≤ 0.6 dB/km
7. 1550 nm: ≤ 0.5 dB/km

H. Maximum required bend radius:
1. At installation: 20x's diameter
2. Long term application: 10x's diameter
3. Zero water entry per FOTP-82, 24 hours immersion
4. Crush resistance: 600N/cm min per EIA-455-41
5. Impact Resistance: 25 impacts, per FOTP-25
6. Flex, Twist/Bend: 25 cycles, per FOTP-104 and FOTP-85

I. Loose Tube Manufacturer:
1. General Cable
2. AFL
3. Approved Equal

2.2 OPTICAL FIBER SPLICE CLOSURE

A. Functions/Features
1. Provide re-enterable underground or inside plant splice closure as shown on the Drawings.
2. Metal Stainless Steel or plastic construction – no corrodible materials.
3. Waterproof, suitable for direct burial.
4. Fusion splice protection chamber.
5. Grommet cable entrance and exits.

B. Manufacturers
1. Preformed Line Products Coyote Series.
2. AFL Apex.
3. Or approved equal.

C. Copper OSP Cabling

2.3 SHIELD CONNECTORS

A. Shield connectors shall make a stable, low-impedance electrical connection between the shield of the communications cable and a conductor such as a strap, bar, or wire.

B. The connector shall be made of tin-plated tempered brass.

C. Shield bond connectors shall comply with REA PE-33.

2.4 GROUNDING BRAID

A. Grounding braid shall provide low electrical impedance connections for dependable shield bonding.

B. The braid shall be made from flat tin-plated copper.

2.5 MULTIPAIR SPLICING CONNECTORS

A. Drawing Reference: None. Provide at all IBTC, TOSC, OTC and similar locations were shown on the plans or required in the field.

B. Function
   1. Can provide gas tight terminate large pair counts of copper cabling to connectorized ends and reliable mate ends in compact area.
   2. Industry standard termination means.
   3. All modules shall have test entry ports on the front side of the module.
   4. All straight splicing modules shall be tap modules.

C. Manufacturer
   1. 3M 710 (Industry standard item).
   2. Or approved equal as required to match the standard used at the facility.

PART 3 - EXECUTION

3.1 GENERAL

A. Provide safety barriers and flag persons for all open manholes and pull-boxes that are in areas accessible to the public.

B. Provide traffic control in accordance with the requirements of Campus policies and standards. Conform to OSHA guidelines when accessing manholes and handholes, inclusive of the requirement for air sampling. Provide continuous measurements. Provide the Owner's Representative with contractor-maintained logs of air samples taken at most two hours apart.

C. Provide sufficient personnel to permit one individual to always remain above the surface, in visual contact with persons in manholes and similar. Provide the observer with an appropriate means of obtaining assistance.

D. Provide ladders for access to manholes. Do not permit workers to use cables or splice cases as ladders.

E. Install a 3/8" nylon pull rope with all underground cables.

3.2 CABLE PULLING

A. Test existing duct lines with a mandrel and thoroughly swab out to remove foreign material before pulling cables.

B. If basket-grip type cable-pulling devices are used to pull cable in place, cut off the section of cable under the grip before splicing and terminating.

C. OSP Copper Cabling Special Procedures
   1. Contractor shall provide notice 2 days in advance notice prior to pulling any cable greater than 400 pairs in size or when a winch is planned for use.
   2. Owner's representative shall have the option to be present to observe all pulling activities of cable greater than 400 pair or when a winch is planned for use.
   3. Contractor shall be responsible for verifying that ducts are ready for occupancy prior to cable placement.

4. Contractor shall assume responsibility for any difficulties or damage to the cable during placement.
5. Adhere to all manufacturers requirements regarding pulling tension allowable lubricants and bending radius.
6. All un-terminated cable pair ends must be cleared (not shorted or crossed) and binder tagged.
7. All open-ended cables must be watertight sealed using temporary end caps or encapsulation.

3.3 CABLES IN MANHOLES, PULL BOXES AND HANDHOLES

A. Support cable splices in underground structures by racks on each side of the splice.

B. 100 ft of slack shall be installed (in aggregate) at one or more maintenance vaults to accommodate possible service outage and cable repairs.

C. Wrap each vault when passing thru each Maintenance Hole.

D. Install cables at middle and bottom of cable racks, leaving top space opening or future cables, except as otherwise indicated for existing installations.

3.4 BUILDING ENTRANCE CONDUIT WATER BARRIER

A. Conduits entering a structure are to penetrate the last vault at the highest elevation possible to prevent water penetration.

B. All Conduits entering a structure are to be sealed and watertight from the last vault to the MPOE, TR or ER.

C. NO conduits shall be sealed (other than fire stopping materials required by the AHJ) inside the structure.

3.5 SERVICE LOOP AND TRANSITION SPLICE AT BUILDING ENTRY

A. For outside plant, flooded cables of 100 pair or greater entering a Building Distribution Facility or Entrance Facility, provide a transition in a splice case, Type IBTC, to non-flooded cable prior to termination on the protector blocks. Unless otherwise indicated on the plans, position the splice case high on the backboard, parallel to the floor at location suitable for service and where gel will not be drawn from the serving outside plant cabling into the IBTC.

B. At Telecommunications Rooms, at both ends of cables, provide at least 20 feet of cable in excess of that required to reach the protectors or terminal block by a dressed route. Form into a storage loop, typically around the perimeter of the backboard and fix in place as directed by the Owner's Representative.

C. Bonding Harnesses shall be used to ground the shields of the spliced cables to the TGB or building service ground. Bonding harness shall be 14 AWG and sized according to closure.

D. Refer to Section 271300 – Communications Backbone Cabling for additional requirements for termination within Telecommunications Rooms.

END OF SECTION

SECTION 271500
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. Other outlet configurations as defined by and coordinated with Owner IT.

B. All Outlet types listed above shall have a slack loop of 10 feet at the field end of the run.

1.4 RELATED SECTIONS

A. 270500 COMMON WORK RESULTS FOR COMMUNICATIONS

B. 270526 GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

C. 270529 HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

D. 270533 CONDUITS AND BACKBOXES FOR COMMUNICATIONS SYSTEMS

E. 270553 IDENTIFICATIONS FOR COMMUNICATIONS SYSTEMS

F. 271116 COMMUNICATIONS CABINETS, RACKS, FRAMES, AND ENCLOSURES

G. 271119 COMMUNICATIONS TERMINATION BLOCKS AND PATCH PANELS

H. 271123 COMMUNICATIONS CABLE MANAGEMENT AND LADDER RACK

I. 271126 COMMUNICATIONS RACK MOUNTED POWER PROTECTION AND POWER STRIPS

J. 271300 COMMUNICATIONS BACKBONE CABLING

K. 271343 COMMUNICATIONS SERVICES CABLING

PART 2 - PRODUCTS

2.1 MODULAR JACK COMPONENTS, GENERAL

A. Modular Jacks rated Category 6A
   1. Panduit Mini-Com CJ6X88TGVL.
   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, unsliced 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 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. 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