University of Colorado Denver
Anschutz Medical Campus

R1 N Rooms 0437 and 0437A Renovate for new MRI (Project A) and R2 Vivarium Fix Paint (Project B)

PN 17-264723 (Project A)
and
PN 17-275293 (Project B)

December 7, 2017
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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Work by University.
4. Work under separate contracts.
5. University-furnished and installed products.
7. Access to site.
8. Coordination with occupants.
10. Specification and drawing conventions.

B. Related Requirements:

1. Section 01 35 46 “Indoor Air Quality Procedures” for requirements and procedures related to maintaining air quality in adjacent occupied spaces and buildings.
2. Section 01 50 00 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of University's facilities and for the provision of temporary construction barriers and dust partitions.

1.3 PROJECT INFORMATION

A. Project Identification  Project # 17-264723 / 17-275293 R 1 N Rooms 0437 and 0437A Renovate for a New MRI (Project A) and R2 Vivarium Fix Paint (Project B)

C. Project Location: Research 1 (R1) and Research 2 (R2) at the University of Colorado Denver Anschutz Medical Campus

D. Principal Representation: University of Colorado Denver.
1. University's Representative: Dan Argersinger, Project Manager, Facilities Management, 1945 Wheeling Street, Aurora CO 80045, Phone 303-724-5681, email: Daniel.Argersinger@ucdenver.edu

E. Architect/Engineer: Polychrome Architecture, Inc. Rachel Rouiller Phone: 303-548-8753 email: Rachel@polychrome-arch.com
F. Architect/Engineer's Consultants: The Architect/Engineer has retained the following design professionals who have prepared designated portions of the Contract Documents: Cater Ruma Associates, Co.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and, in summary, briefly consists of the following:

1. Project A: Renovation to R1 North rooms 0437 and 0437A to renovate for a new MRI. The project requires minimal demolition and modification to existing electrical and mechanical systems.

   Project B: Renovation to R2 Vivarium Level, tunnel connecting R2 and R1 and a small portion of the Vivarium Level of R1 to clad all walls and ceilings with FRP panels. The project requires minimal removal of peeling existing paint and the removal of wall and ceiling mounted items to facilitate the installation of the FRP panels.

2. All work is identified on the attached drawings.

1.4 WORK BY UNIVERSITY

A. General: Cooperate fully with University so work may be carried out smoothly, without interfering with or delaying work under this Contract or work by University. Coordinate the Work of this Contract with work performed by University.

1.5 WORK UNDER SEPARATE CONTRACTS

A. General: Cooperate fully with separate contractors so work on those contracts may be carried out smoothly, without interfering with or delaying work under this Contract or other contracts. Coordinate the Work of this Contract with work performed under separate contracts.

1.6 UNIVERSITY-FURNISHED AND INSTALLED PRODUCTS

A. Equipment and furniture.

1.7 UNIVERSITY-FURNISHED, CONTRACTOR-INSTALLED PRODUCTS Not Used

1.8 ACCESS TO SITE

A. General: Contractor shall have limited and restricted use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.

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

1. Adjust means and methods of construction based on site limits and restrictions.
2. Locate staging areas only where permitted by University.
3. As part of this Project, replace damaged lawns, sprinkler systems, sidewalks and any other existing site improvements within staging area and access ways.
C. Construction Access and Travel:

1. Use only those entrances, exits, and travel ways on campus roads and within the building designated by University. Contractor's personnel are not permitted in non-designated areas of University's existing facilities. Use only designated travel ways for transporting demolition materials, new construction materials, tools and equipment.

2. Use of other than designated travel ways on campus roads and within existing buildings requires a minimum of 20 business days prior approval by University.

   a. Request variations to traffic flow including temporary fire lane, parking lot, sidewalk and road closures, regulatory signage, and traffic control devices in accordance with University “Procedure for Approval of Regulatory Signage, Traffic Control Devices and for Street Closures at the Anschutz Medical Campus” and “AMC Campus Street and Parking Lot Closure Request” available through University Project Manager.

3. Access to the site will be as permitted by the University. Prearrange delivery and use of cranes, heavy trucks and other heavy equipment at least 72 hours prior to need through the University’s Project Manager and University Police.

4. Maintain access to fire lanes and campus operations at all times. Provide flag personnel during the ingress or egress of large equipment.

   a. When fire lanes and/or access way must be temporarily disrupted notify University Police and University Parking and Transportation at least 20 business days in advance and reconfirm 72 hours in advance through the University’s Project Manager.

5. Arrange for and obtain all necessary permits from City of Aurora for any disruption to or temporary closures of public city streets. Coordinate procurement of permits with Anschutz Medical Campus Liaison and University Project Manager.

D. Construction Parking:

1. General: Contractor must pay for all parking and, if available, may be assigned parking spaces in designated contractor parking lots. Parking in lots designated for visitors and patients is not permitted. Make arrangements for designated spaces and payment for long term parking with University Parking Services through the University Project Manager.

2. Provide temporary parking or use designated areas of University’s existing parking areas as applicable to the Project and in accordance with the following:

   a. All parking on University property, including parking on University owned streets, is under the exclusive control and authority of University Parking and Transportation Services. Direct policy question to the department at (303) 724-2555.

   b. There is no free parking on campus. Displacement or use of existing parking spaces by Contractor, either for parking or for staging, is a Contractor cost.

   c. Use of existing parking spaces or other areas outside of Contractor’s staging area must be approved in advance by University Parking and Transportation Services.

   d. University Parking and Transportation Services may require and issue parking permits through the University Project Manager. Permits must be displayed and visible at all times while parked on the campus. Failure to display a permit will result in citations being written and possible removal of the vehicle from University property.

   e. Keep all designated parking areas clean and free of litter and debris. University reserves the right to direct Contractor to clean areas not kept clean and orderly.

   f. University Parking and Transportation Services may change parking assignments as deemed necessary, restrict the use of any space(s) or lot(s) at any time, and determine the hours of control and mode of operations for any parking area at any time. University Parking and Transportation Services may deny or revoke parking privileges to any person when deemed necessary and/or considered to be in the best interests of the University.
3. Parking on University property is at the Contractor’s own risk. The University and any entity affiliated with it are not responsible for fire, theft, and damage to or loss of contractor’s or subcontractor’s vehicle or any article left therein. Only a license is granted to the user and no bailment is created.

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

1.9 COORDINATION WITH OCCUPANTS

A. University may occupy site and both existing and adjacent building(s) during entire construction period. Cooperate with University during construction and sequence operations to minimize conflicts and facilitate University usage. Perform the Work so as not to interfere with University's day-to-day operations.

1. Maintain existing exits from existing and adjacent building, unless otherwise indicated.
2. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from University and approval of authorities having jurisdiction.
3. Limit construction operations to those methods and procedures which will not adversely and unduly affect the working environment of University's occupied spaces, including noise, dust, odors, air pollution, ambient discomfort, poor lighting, hazards and other undesirable effects and conditions.
4. Coordinate with University Project Manager to schedule jack hammering or activities producing dusty conditions, excessive fumes or odors during off-hours.
5. When work must be accomplished in areas containing existing furniture, upon a minimum of 3 business days notification of the University Project Manager, University will remove or relocate existing furniture.
6. Provide not less than 72 hours' notice to University Project Manager of activities that will affect University's operations. University Project Manager will coordinate with campus tenants.

a. Refer to “Work Restrictions” Article of this Section for procedures and notification requirements related to utility interruptions.

7. Provide temporary barriers and partitions, or other means as required to protect occupants of existing building and the general public from injury due to construction activities. Prevent the spread of dust and dirt to adjacent occupied areas and building.

1.10 WORK RESTRICTIONS

A. Work Restrictions, General: Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.
2. In planning and executing the Work, take into consideration the special needs of University patient care, teaching and research settings, for example, supply of critical utilities, noise and dust control, access to existing loading docks, occupied buildings, etc.

B. Normal Working Hours: Limit work to normal working hours of 7:00 a.m. to 6:00 p.m., Monday through Friday.
1. Notify University Project Manager of all proposed work outside of normal working hours. Include dates, times, names and contact information for contractors and subcontractor performing the Work with notification. University Project Manager will notify, as appropriate, other University personnel and departments including, but not limited to, Building Maintenance and Operations (BMO) Directors, BMO assigned representative, Campus Police and Facilities Management.

C. Noise and Vibration: Coordinate operations that may result in high levels of noise and vibration, or other disruption to University occupancy with University.

1. Noise during Normal Working Hours: Identify potentially disruptive construction activities at weekly Progress Meeting and adjust active time of day to reduce significant impacts on occupants.
2. Noise outside Normal Working Hours: Schedule construction work or demolition work outside of normal working hours with University Project Manager at minimum of 72 hours in advance.
   a. The maximum permissible noise level is 75 decibels (dBA), measured at the adjacent property line.

D. Contractor Identification:

1. Supervisory staff for the primary contractor must obtain an identification badge at the University Anschutz Medical Center (AMC) Building 500. Submit the University Access Control Badge Application form through University Project Manager. Submitted forms shall be complete with all required information including a letter on company letterhead confirming employee status with company and stating whether the company completes background testing and/or drug screening. Contractor supervision must display badge on site during construction activities.
2. To the greatest extent possible, Contractor’s and subcontractor’s employees must wear a recognizable logo shirt or hardhat identifying them as members of the contractor’s work force.

E. Use of Existing Elevators: Use “freight” elevators only and protect finishes during transport. Restrict use exclusively to time required to move construction materials.

1. Do not block corridors, aisles, passageways or doors leading to elevator except as, and only to the extent approved by University Project Manager.

F. Keys: Submit written request to University Project Manager on University Key Request Form.

1. To the extent the need for keys is demonstrated and required to complete the Work, University Project Manager will issue keys to Contractor.
2. Contractor is responsible for all costs related to lost or non-returned keys.
3. Electrical, mechanical and sensitive research space may require University escort in lieu of issuing keys.

G. Dock Deliveries: Restrict use exclusively to time required to unload and move construction materials.

H. Existing Utility Interruptions: Do not interrupt water, sewer, plumbing, gas, steam, chilled water, oxygen, HVAC, electrical power, lighting, telephone and other related utilities serving facilities occupied by University without prior notice to and approval by the University. Coordinate and schedule interruptions in advance through the University Project Manager in strict conformance with University Utility Interruption/Outage Request Procedure.

1. Form of Notice: University Utility Interruption and Start-up Request form.
2. Time of Notice: Notice for major and minor outages as defined by the Utility Interruption/Outage Request Procedure is 8 business days for minor outages and 31 business days for major outages.
I. Fire Alarm and Fire Sprinkler Interruptions: When construction activities require interruption of fire alarm or fire sprinkler service, or when dust from construction activities is likely to cause accidental alarm, advise University Project Manager who will submit an interruption request.

1. Form of Notice: University Fire Alarm/Sprinkler Disable Request Form.
2. Time of Notice: Prior to noon on the day before the anticipated interruption.

J. Nonsmoking Campus: Smoking, chewing tobacco, and other related tobacco product use is not permitted at any location on campus or on any adjacent property.

K. University Policies Applying to All Contractors: Comply with University policies applying to contractors including drug policy, sexual harassment policy and tobacco free policy. Obtain copies of University policies from University Project Manager.

1. Controlled Substances: Use of tobacco products and other controlled substances on Project site and surrounding Campus is not permitted.

L. Designated Eating Areas: Restrict consumption of food on project site to designated eating areas as approved by University Project Manager.

1.11 SPECIFICATION AND DRAWING CONVENTIONS

A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
3. Words in the singular number include the plural and those in the plural include the singular.
4. Words of any gender include any other gender.

B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:

1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
2. Abbreviations: Materials and products are identified by abbreviations published as part of the U.S. National CAD Standard and scheduled on Drawings.
3. Keynoting: Materials and products may be identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 10 00
SECTION 01 26 00

CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

B. Related Requirements:

1. Section 01 25 00 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.

2. Construction Manager/General Contractor Agreement (CM/GC), State Form SC-6.4 and The General Conditions of the Construction Contract, State Form SC-6.23 for definitions and contractual requirements related to contract modification procedures.

1.3 DEFINITIONS

A. Change Order: A written order in compliance with the requirements of the Contract authorizing changes in the Work. For the purposes of this Section a Change Order and a Contract Amendment shall have the same meaning.

1.4 INFORMATIONAL SUBMITTALS

A. Contractor’s Authorized Signatory: Submit name of individual authorized to accept changes and responsible for informing others employed by Contractor of changes in the Work.

1.5 MINOR CHANGES IN THE WORK

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

1.6 CHANGE ORDER BULLETIN

A. University-Initiated Change Order Bulletin: Architect/Engineer will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications. It will also state the time period for which the request will remain valid.
2. Work Change Order Bulletins issued by Architect/Engineer are not instructions either to stop work in progress or to execute the proposed change.

B. Contractor-Initiated Change Order Bulletin: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect/Engineer.

2. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.

1.7 CHANGE ORDER PROPOSAL

A. Change Order Proposal: In response to a University-Initiated Change Order Bulletin or accompanying a Contractor-Initiated Change Order Bulletin, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change described.

2. Labor Rates: Prior to submitting first Change Order Proposal, submit bare, unburdened hourly labor rates for all contractor and subcontractor labor categories; submit itemized breakdown of all applicable additional labor benefit costs to be added to the bare labor cost to arrive at the total burdened hourly labor cost.
3. Equipment Costs: Provide cost backup for all equipment clearly indicating equipment billing rates and sufficient to demonstrate, as determined by the University Project Manager, that proposed rates are competitive and reasonable in all cases. Submit completed Change Order Proposal Form within the requested timeframe. Include backup documentation to support calculations consistent with Contract provisions, including but not limited to, the following:
   a. Contractor and Subcontractor labor, material and equipment costs including:
      1) A list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
      2) Applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
      3) Costs of labor and supervision directly attributable to the change and as permitted by the terms and conditions of the General Contract for Construction.
   b. Contractor and Subcontractor overhead and profit.
   c. Contractor’s bond cost.
   d. Justification for Change in Contract Time: An updated Contractor’s construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
4. Maintain detailed records of work completed. Provide complete information for evaluation of proposed changes and to substantiate proposed changes in Contract Sum or Contract Time.
1.8 ADMINISTRATIVE CHANGE ORDERS

A. Allowance Adjustment: See Section 01 21 00 "Allowances" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect actual costs of allowances.

B. Unit-Price Adjustment: See Section 01 22 00 "Unit Prices" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect measured scope of unit-price work.

1.9 CHANGE ORDER PROCEDURES

A. Submit three signed copies of Change Order Proposal to Architect/Engineer for review.

1. University-Initiated Change Order Bulletins: University and Architect/Engineer will evaluate Contractor’s Change Order Proposal and either request additional information or suggest modifications. Based on this review and evaluation University will either accept or reject the proposal.

2. Contractor-Initiated Change Order Bulletins: Architect/Engineer will evaluate Contractor’s claim based on the terms and conditions of the Contractor Agreement and General Conditions of the Construction Contract, as applicable.

3. Architect/Engineer’s Action: When satisfied as to the accuracy and completeness of the Change Order Proposal, the Architect/Engineer will sign all three copies and forward to the University for consideration.

B. On University's approval of a Change Order Proposal, Architect/Engineer will prepare, sign and forward three copies of a Change Order, State Form SC-6.31 available from the website of the Office of the State Architect, for signature by the Contractor. Contractor then forwards all three copies of signed Change Order to the University for signature and distribution of fully executed copies to Architect/Engineer and Contractor for record.

C. Upon receipt of a fully executed Change Order, promptly perform the following:

1. Revise Schedule of Values on the Application for Payment Form by indicating each authorized Change Order as a separate line item and adjusting the Contract Sum as shown on the Change Order.

   a. University will not pay for changes to the Work until authorized by a Change Order signed by all parties.

2. Revise the Progress Schedule to reflect any change in the Contract Time.

3. Enter changes in the Project Record Documents.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 26 00
SECTION 01 29 00
PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

B. Related Requirements:

1. Section 01 21 00 "Allowances" for procedural requirements governing the handling and processing of allowances.
2. Section 01 22 00 "Unit Prices" for administrative requirements governing the use of unit prices.
3. Section 01 26 00 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
4. Section 01 32 00 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.
5. For projects required to obtain LEED certification, Division 01 Section "Sustainable Design Requirements" for administrative requirements governing submittal of cost breakdown information required for LEED documentation.

1.3 DEFINITIONS

A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.4 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule. Schedule of values report from cost-loaded Critical Path Method Schedule prepared in accordance with Section 01 32 00 “Construction Progress Documentation” may serve to satisfy requirements for the schedule of values.

1. Coordinate line items in the schedule of values with other required administrative forms and schedules, including the following:

   a. Application for Payment forms with continuation sheets.
   b. Submittal schedule.
   c. Items required to be indicated as separate activities in Contractor's construction schedule.

       1) Construction Manager’s Fee.
2) Estimated Project General Conditions Costs.

2. Submit schedule of values and hold a conference with the Architect/Engineer and University Project Manager to finalize the schedule of values at earliest possible date, but no later than 10 business days before the date scheduled for submittal of initial Certificates and Applications for Payment.

B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.

1. Identification: Include the following Project identification on the schedule of values:
   a. Project name and location.
   b. Name of Architect/Engineer.
   c. Architect/Engineer's project number.
   d. Contractor's name and address.
   e. Date of submittal.

2. Arrange schedule of values consistent with format of AIA Document G703.

   a. Include separate line items under Contractor and principal subcontracts for LEED documentation, where applicable, and other Project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.

4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.

5. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
   a. Differentiate between items stored on-site and items stored off-site. If required, include evidence of insurance.

6. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
   a. Temporary facilities and other major cost items that are not a direct cost of actual work-in-place shall be shown as separate line items in the schedule of values.

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

1.5 APPLICATIONS FOR PAYMENT

A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Architect/Engineer and paid for by University.

1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.
B. Pay Application and Schedule Review Meetings: Conduct in accordance with Section 01 31 00 “Project Management and Coordination.” Provide draft application for payment and draft schedule update reflecting work accomplished during previous pay period. Review progress achieved; discuss and resolve issues affecting the progress; and review critical activities to be accomplished during the following 90 calendar days.

1. Jobsite Walk: When required, conduct a walk of the jobsite to confirm progress related to any activity in question.

C. Monthly Schedule Reporting: Upon conclusion of the Pay Application and Schedule Review Meeting, but not later than the 28th of the month, update the Construction Schedule and submit the Pay Application.

D. Payment Application Times: Submit Application for Payment to Architect/Engineer by the first day of the month and no more than five (5) business days prior thereto. The period covered by each Application for Payment is per the date indicated in the Application.

E. Payment Application Review: The Architect/Engineer shall, within five (5) business days after the receipt of each Certificate and Application for Payment, review the Project Application for Payment and either execute a Project Certificate for Payment to the University or notify the Contractor in writing of the reasons for withholding a Certificate.

1. All applications for payment, except the final application, and the payments there under, shall be subject to correction in the next application rendered following the discovery of any error.

F. Application for Payment Forms: Use State Form SBP-7.2 “Certification for Contractor Payment.”

G. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect/Engineer will return incomplete applications without action.

1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
3. Include amounts of Change Orders issued before last day of construction period covered by application.
4. Indicate separate amounts for work being carried out under University-requested project acceleration.

H. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site as approved in advance by the University Project Manager and items stored at an off-site location previously agreed upon in writing.

1. Provide certificate of insurance, evidence of transfer of title to University, and consent of surety to payment, for stored materials.
2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
3. Provide summary documentation for stored materials indicating the following:
   a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.

c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.

I. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Architect/Engineer by a method ensuring receipt. One copy shall include waivers of lien and similar attachments if required.

1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

J. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:

1. List of subcontractors.
2. Schedule of values.
3. For projects required to obtain LEED certification, LEED submittal for project materials cost data.
4. Contractor's construction schedule (preliminary if not final).
5. Products list (preliminary if not final).
6. For projects required to obtain LEED certification, LEED action plans.
7. Schedule of unit prices.
8. Submittal schedule (preliminary if not final).
9. List of Contractor's staff assignments.
10. List of Contractor's principal consultants.
13. Initial progress report.

K. Application for Payment at Substantial Completion: After Architect/Engineer issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.

1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
2. This application shall reflect Certificate(s) of Substantial Completion issued previously for University occupancy of designated portions of the Work.

L. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited to, the following:

1. All items on Pre-acceptance Checklist (State Form SBP-05) have been completed.
2. Notice of Acceptance (State Form SBP-6.27) has been issued.
3. Statements to support local sales tax refunds, if any submitted.
4. Notice of Contractor's settlement has been published.
5. Evidence of completion of Project closeout requirements, including but not limited to:

a. Submittal of Record Documents.

b. Submittal of all Operation and Maintenance Manuals.

c. Completion of all required demonstration and training.

6. Updated final statement, accounting for final changes to the Contract Sum.
7. Evidence that claims have been settled.
8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when University took possession of and assumed responsibility for corresponding elements of the Work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 29 00
SECTION 01 31 00

PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:

1. General coordination procedures.
2. Coordination drawings.
3. Requests for Information (RFIs).
4. Project Web site.
5. Project meetings.

B. Related Requirements:

1. Section 01 32 00 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
2. Section 01 73 00 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
3. Section 01 77 00 "Closeout Procedures" for coordinating closeout of the Contract.

1.3 DEFINITIONS

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

1.4 INFORMATIONAL SUBMITTALS

A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Within 21 calendar days of Notice of Award submit, as complete as possible, a preliminary list to include all major subcontractors. Augment, complete and submit the final subcontractor list within 60 calendar days of Notice of Award, unless a longer duration is approved by the Architect/Engineer. Include the following information in tabular form:

1. Name, address, and telephone number of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.
3. Drawing number and detail references, as appropriate, covered by subcontract.
B. Key Personnel Names: Within 14 calendar days after Notice to Proceed, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.

1.5 GENERAL COORDINATION PROCEDURES

A. General: Each entity involved in the performance of work for the entire Project shall cooperate in the overall coordination of the Work; promptly, when requested, furnish information concerning its portion of the Work; and respond promptly and reasonably to the decisions and requests of persons designated with coordination, supervision, administrative or similar authority.

1. University Standard Project Management Forms
   a. Where applicable, obtain from the University Project Manager and use the following University Standard Forms:
      1) Preconstruction Agenda
      2) Change Order Log with Contingency Codes
      3) Access Control Badge Application Form
      4) Utility Interruption Request Form
      5) Utility Start-Up Request Form
      6) Fire Alarm/Sprinkler Disable Request Form
      7) Hot Work Permit Form
      8) Anschutz Medical Campus (AMC) Street and Parking Lot Closure Form
      9) Indoor Air Quality (IAQ) Planning Checklist
      10) Indoor Air Quality (IAQ) Inspection Checklist

2. Site Utilization:
   a. In addition to the site utilization limitations and requirements indicated in Section 01 10 00 “Summary” and indicated by the Contract Documents; administer the allocation of available space equitably among entities needing access and space, so as to produce the best overall efficiency in the performance of the total work of the project. Schedule deliveries so as to minimize the space and time requirements for storage of materials and equipment on the site; but do not unduly risk delays in the work.
   b. Concurrent with work of the Contractor, other contractors, suppliers, and the University personnel may be working in relatively close proximity. The Contractor is solely responsible for coordinating their work with that of other contractors and will make no claims for failure to do so.

3. Layout:
   a. It is recognized that the Contract Documents are diagrammatic in showing certain physical relationships of the various elements and systems and their interfacing with other elements and systems. Establishment and coordination of these relationships is the exclusive responsibility of the Contractor. Do not scale the drawings. Lay out and arrange all elements to contribute to safety, efficiency and to carry the harmony of design throughout the Work. In case of conflict or undimensioned locations, verify required positioning with Architect/Engineer.

4. Substrate Examination:
a. The Installer of each element of the work must examine the conditions of the substrate to receive the work, dimensions and spaces adjacent, tolerances, interfacing with other elements and services, and the conditions under which the work will be performed, and must notify the Contractor in writing of conditions detrimental to the proper or timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

5. Large and Heavy Equipment:

a. Contractor to coordinate with University Project Manager requirements to be maintained for the subsequent entry of large equipment units. Coordinate the movement of heavy items with shoring and bracing, so that the building structure will not be overloaded during the movement and installation.

b. Where equipment or products to be installed on the roof are too heavy to be hand-carried, do not transport across roof deck; position by crane or other device so as to avoid overloading the roof deck.

B. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections of the Specification that depend on each other for proper installation, connection, and operation.

1. Contractor Communication with the University: Direct all communication with the University through the University Project Manager.

2. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.

3. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.

4. Make adequate provisions to accommodate items scheduled for later installation.

C. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

1. Prepare similar memoranda for University and separate contractors if coordination of their Work is required.

D. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Contractor's construction schedule.

2. Preparation of the schedule of values.

3. Installation and removal of temporary facilities and controls.

4. Delivery and processing of submittals.

5. Progress meetings.

6. Preinstallation conferences.

7. Project closeout activities.

8. Startup and adjustment of systems.

E. Coordination Of Submittals: Prior to transmittal to the Architect/Engineer, review shop and erection drawings, product data, and samples for compliance with Contract Documents and for coordination among work of all Sections of the Specifications. Coordination of submittals shall include, but not be limited to the following:
1. Verification of field dimensions and clearances and relationship to available space and anchors.
2. Verification of compatibility with equipment and work of other Sections, electrical characteristics, and operational control requirements.
3. Verification of motor voltages and control characteristics.
4. Coordination of controls, interlocks, wiring of pneumatic switches, and relays.
5. Coordination of wiring and control diagrams.
6. Review of the effect of any changes on work of other Sections.
7. For any item to be installed in or on a finished surface, certify that applicable Contract Documents have been checked and that the item submitted is compatible with the surface finish on which it is to be installed.
8. Equipment and material submittals shall show sufficient data to indicate complete compliance with Contract Documents as follows:
   a. Proper sizes and capabilities.
   b. Ability to fit in the available space in a manner that will allow proper service.
   c. Construction methods, materials, and finishes.
   d. List of accessories.

F. Special Coordination Requirements for Mechanical and Electrical Work:

1. General: Provide necessary work and services required to coordinate the complete installation of heating, ventilating, and air conditioning (HVAC) equipment and systems; plumbing systems and fixtures; electrical equipment, fixtures, and systems; and other equipment or systems containing motors and controls or requiring connection to mechanical or electrical systems; all so that the various systems perform as indicated and are in harmony with other project Work.
2. Contract Drawings:
   a. Drawings are schematic in nature, and indicate in general how the various components are integrated with other parts of the building. Coordinate exact locations by job measurement, by verifying the requirements of other trades, and by review of Contract Documents.
3. Mechanical and Electrical Drawings indicate general routing of the various parts of the systems, but do not indicate all sizes, fittings, offsets, and runouts which are required. Coordinate correct sizes, fittings, offsets, and runouts required to fit systems into allocated spaces. Coordinate locations of all light fixtures, vents, and supply grilles to conform to the ceiling grid system or other modular finishes.
4. Coordinate installation of mechanical and electrical work in compliance with the following requirements:
   a. Install piping, ductwork and similar services straight and true, aligned with other work, close to walls and overhead structure, allowing for insulation, concealed (except where indicated as exposed) in occupied spaces, and out-of-the-way with maximum passageway and headroom remaining in each space.
   b. Install electrical work in a neat, organized manner with conduit and similar services in or parallel with building lines, and concealed unless indicated as exposed.
   c. For all work maintain maximum practical overhead clearance but not less than 6" above ceiling. Where exposed, maintain 7'-0" minimum clearance.
   d. Arrange all work to facilitate maintenance and repair or replacement of equipment. Locate services requiring maintenance on valves and similar units in front of services requiring less maintenance. Connect equipment for ease of disconnecting, with minimum of interference with other work.
   e. Provide space to permit removal of coils, tubes, fan shafts, filters, other parts which may require replacement.
   f. Locate operating and control equipment and devices for easy access. Furnish access panels where units are concealed by finishes and similar work.
g. Integrate mechanical work in ceiling plenums with suspension system, light fixtures and other work, so that required performances of each will be achieved.

h. Give the right-of-way to piping systems required to slope for drainage over other service lines and ductwork.

i. Advise other trades of openings required in their work for accommodation of mechanical and electrical elements. Provide and place sleeves and anchors required in other work.

5. Access to Equipment: Except where located above accessible ceilings, provide access panels wherever access is required to concealed valves, controls, dampers, pull boxes and other devices requiring ongoing or periodic access.

   a. Acceptable types of access panels are specified in Division 08.
   b. Each trade is responsible for providing access panels needed for access to their equipment and coordinating installation with other Division 03, 04, 06 and 09 trades.
   c. Coordinate requirements and obtain approval of locations from Architect/Engineer.

G. Compatibility of Systems:

1. Provide products and equipment which are compatible with other work requiring mechanical/electrical interface including electrical connections, control devices, water, drain and other piping connections. Verify electrical characteristics, fuel requirements and other interface requirements before ordering equipment and resolve conflicts that may arise.

2. Coordinate equipment, mechanical and electrical work in accordance with the following schedule:

<table>
<thead>
<tr>
<th>ITEM</th>
<th>FURNISHED BY</th>
<th>MOUNTED BY</th>
<th>LOW VOLTAGE WIRED BY</th>
<th>POWER WIRED &amp; CONNECTED BY</th>
<th>LOW VOLTAGE CONTROL CONNECTED BY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equipment motors</td>
<td>I</td>
<td>MI</td>
<td>MI</td>
<td>EI</td>
<td>--</td>
</tr>
<tr>
<td>Motor starters, contactors and overload heaters</td>
<td>MI</td>
<td>EI</td>
<td>EI</td>
<td>EI</td>
<td>MI</td>
</tr>
<tr>
<td>Fused and unfused disconnect switches</td>
<td>EI**</td>
<td>EI**</td>
<td>EI**</td>
<td>EI</td>
<td>--</td>
</tr>
<tr>
<td>Manual operating switches, speed switches, push-button stations and pilot lights</td>
<td>MI</td>
<td>EI</td>
<td>EI</td>
<td>EI</td>
<td>EI</td>
</tr>
<tr>
<td>Duct detectors</td>
<td>EI</td>
<td>MI</td>
<td>MI</td>
<td>EI</td>
<td>MI</td>
</tr>
<tr>
<td>Control relays and transformers</td>
<td>MI</td>
<td>MI</td>
<td>MI</td>
<td>EI</td>
<td>MI</td>
</tr>
<tr>
<td>Thermostats, time switches*</td>
<td>MI</td>
<td>MI</td>
<td>MI</td>
<td>EI</td>
<td>MI</td>
</tr>
<tr>
<td>Temperature control panels</td>
<td>MI</td>
<td>MI</td>
<td>MI</td>
<td>EI</td>
<td>MI</td>
</tr>
<tr>
<td>Motor and solenoid valves, damper motors, PE and EP switches</td>
<td>MI</td>
<td>MI</td>
<td>MI</td>
<td>--</td>
<td>MI</td>
</tr>
<tr>
<td>Refrigeration equipment, cooling tower and controls</td>
<td>MI</td>
<td>MI</td>
<td>MI</td>
<td>EI</td>
<td>MI</td>
</tr>
</tbody>
</table>
Electric meters | EI | EI | EI | EI | MI  
Steam meters   | MI | MI | MI | MI | MI  
Chilled water meters, | MI | MI | MI | MI | MI  
Water meters   | MI*** | MI | MI | MI | MI  
Natural Gas    | MI | MI | MI | MI | MI  

I = Installer of equipment requiring electrical service  
EI = Electrical Installer  
MI = Mechanical Installer  

* Motor driven units which are controlled from line voltage automatic controls such as line voltage thermostats, float switches or time switches which conduct full load current of the motor shall be wired for both power and control circuit under the electrical contract. However, if the control device does not conduct full load current, then the responsibility shall be that set forth in the above schedule. (Example: a 208 volt, 3-phase, 3-wire motor requires 120 volt control. Electrical Installer shall furnish a 120 volt circuit for control and 208 volt circuit for power and wire the power circuit. Mechanical Installer shall wire the control circuit.)

** Disconnects for AH units are factory mounted.

***Building Service meter provided by Civil. Any sub meter provided by MI. Coordinate meter requirements with utility for remote monitoring by 23 09 00 – Instrumentation and Controls.

H. Special Coordination Requirements for Exterior Envelope Work:

1. General: Provide necessary work and services required to coordinate the complete and continuous installation of the building’s heat, air and moisture barriers. Exterior building envelope construction to be coordinated includes, but is not limited to, below-grade walls, slabs-on-grade, exterior opaque walls, windows, curtain walls, roofs, and skylights.

2. Contract Drawings:

   a. Drawings indicate general concepts and design intent for continuity of heat, air and moisture barriers at each exterior building envelope component and at transitions between building envelope components. Coordinate details for continuity based on actual product selections and Contractor’s proposed sequence of construction.

I. Complete Systems:

1. It is the intent of the Contract Documents that all systems, including mechanical and electrical, be complete and functional to provide the intended or specified performance. Provide all incidental items and parts necessary to achieve this requirement.

2. Provide correctly sized power, utilities, piping, drains, services and their connections to equipment and systems requiring them, whether or not specific items are listed in the schedule under “Compatibility of Systems” paragraph in this Section.

J. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.

1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as University’s property.
2. Establish recycling program at job site. Refer to Section 01 74 19 “Construction Waste Management and Disposal” for additional requirements.

1.6 REQUESTS FOR INFORMATION (RFIs)

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

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

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

1. Project name.
2. Project number.
3. Date.
4. Name of Contractor.
5. Name of Architect/Engineer.
6. RFI number, numbered sequentially.
7. RFI subject.
8. Specification Section number and title and related paragraphs, as appropriate.
9. Drawing number and detail references, as appropriate.
10. Field dimensions and conditions, as appropriate.
11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
12. Contractor's signature.
13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
   a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

C. RFI Forms: Hard copy form or software-generated form with substantially the same content as indicated above, acceptable to Architect/Engineer.

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

D. Architect/Engineer's Action: Architect/Engineer will review each RFI, determine action required, and respond. Allow seven calendar days for Architect/Engineer's response for each RFI. RFIs received by Architect/Engineer after 1:00 p.m. will be considered as received the following working day.

1. The following Contractor-generated RFIs will be returned without action:
   a. Requests for approval of submittals.
   b. Requests for approval of substitutions.
   c. Requests for approval of Contractor's means and methods.
   d. Requests for coordination information already indicated in the Contract Documents.
   e. Requests for adjustments in the Contract Time or the Contract Sum.
f. Requests for interpretation of Architect/Engineer's actions on submittals.
g. Incomplete RFIs or inaccurately prepared RFIs.

2. Architect/Engineer's action may include a request for additional information, in which case Architect/Engineer's time for response will date from time of receipt of additional information.

3. Architect/Engineer's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Contractor-Initiated Change Order Bulletin and Proposal according to Section 01 26 00 "Contract Modification Procedures."

   a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect/Engineer in writing within seven calendar days of receipt of the RFI response.

E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by RFI number. Submit log weekly. Use CSI Log Form 13.2B or Contractor-generated form of substantially same content. Include the following:

1. Project name.
2. Name and address of Contractor.
3. Name and address of Architect/Engineer.
4. RFI number including RFIs that were returned without action or withdrawn.
5. RFI description.
6. Date the RFI was submitted.
7. Date Architect/Engineer's response was received.

F. On receipt of Architect/Engineer's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect/Engineer within seven calendar days if Contractor disagrees with response.

1.7 PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify University and Architect/Engineer of scheduled meeting dates and times a minimum of 4 business days prior to meeting.

   a. Participants, including representatives of subcontractors and suppliers, shall be qualified, familiar with Project and authorized to conclude matters relating to the Work.

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

3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including University and Architect/Engineer, within three business days of the meeting.

B. Preconstruction Conference: Schedule and conduct a preconstruction conference before starting construction, at a time and site convenient to all parties, but not later than 14 calendar days after Notice to Proceed.

1. Conduct the conference to review responsibilities and personnel assignments.

2. Attendees: Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work and include the following:

   a. Authorized representatives of University:
1) University Project Manager.
2) University Building Maintenance Operations (BMO) Representative.

b. Architect/Engineer and their consultants.
c. Contractor’s project manager and superintendent.
d. Major subcontractors and suppliers.
e. Other concerned parties shall attend the conference.

3. Agenda: Discuss items of significance that could affect progress, including the following:

a. Designation of key personnel and their duties.
b. Lines of communications.
c. List of major subcontractors and suppliers.
d. Tentative construction schedule.

   1) Phasing.
   2) Critical work sequencing and long-lead items.
   3) Equipment deliveries and priorities.

e. Procedures and processing of:

   2) RFI’s.
   3) Testing and inspecting.
   4) Applications for Payment.
   5) Submittals.
   6) Preparation of record documents.

f. Use of the premises, existing building and adjacent buildings as applicable.

   1) Work restrictions.
   2) Working hours.
   3) University's occupancy requirements.
   4) Procedures for disruptions and shutdowns.
   5) Construction parking and staging.
   6) Construction route and site access.
   7) Office, work, and storage areas.
   8) Progress cleaning and housekeeping procedures.

g. Project coordination.
h. Distribution of the Contract Documents.
i. Temporary facilities and controls.
j. Indoor Air Quality Plan and Monitoring including procedures for moisture and mold control.
k. Construction waste management and recycling.
l. Safety.

   1) Fire and Life Safety.
   2) Health and Safety.

m. First aid.
n. Security.
o. Building Department.
p. Telecommunications.
q. Building Services.
r. Building Operations.
s. University Work Related Policies.
t. Contractor Contacts.
u. University Contacts.
v. University Process Forms.

1) Key Request Form.
2) Access Control Badge Application Form.
3) Utility Interruption Request Form.
4) Utility Start-Up Form.
5) Fire Alarm/ Sprinkler Disable Request Form.
6) Hot Work Permit Form.
7) Anschutz Medical Campus (AMC) Street and Parking Lot Closure Form.
8) Indoor Air Quality (IAQ) Plan.
9) IAQ Planning Checklist.
10) IAQ Inspection Checklist.
11) Request for Variance.

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

C. Preinstallation Conferences: Conduct a preinstallation conference at Project site for installations, systems or assemblies where required by individual Specification Sections, or where deemed necessary by Contractor.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect/Engineer of scheduled meeting dates.

2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following, as appropriate:

b. Options.
c. Related RFI’s.
d. Related Change Orders.
e. Purchases.
f. Deliveries.
g. Submittals.
h. LEED requirements, for projects pursuing LEED certification.
i. Review of mockups.
j. Possible conflicts.
k. Compatibility requirements.
l. Time schedules.
m. Weather limitations.
n. Manufacturer’s written instructions.
o. Warranty requirements.
q. Acceptability of substrates.
r. Temporary facilities and controls.
s. Space and access limitations.
t. Regulations of authorities having jurisdiction.
u. Testing and inspecting requirements.
v. Installation procedures.
w. Coordination with other work.
x. Required performance results.
y. Protection of adjacent work.
z. Protection of construction and personnel.

3. Record significant conference discussions, approved schedules, agreements, and disagreements, including required corrective measures and actions.

4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information, including University Project Manager and Architect/Engineer.

5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

D. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to University and Architect/Engineer, but no later than 30 calendar days prior to the scheduled date of Substantial Completion or Partial Substantial Completion.

1. Conduct the conference to review requirements and responsibilities related to Project closeout.
2. Attendees: Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work and include the following:
   a. University Project Manager.
   c. Architect/Engineer and their consultants.
   d. Contractor’s project manager and superintendent.
   e. Major subcontractors and suppliers.
   f. Other concerned parties.

3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
   a. Procedures related to:
      1) Notice of Completion, including preparation of Contractor’s punch list.
      2) Final Inspection.
      3) Notice of Substantial Completion.
      4) Notice of Approval of Occupancy/Use.
      5) Supplemental Occupancy/Use Checklist.
      6) Supplemental Acceptance Checklist.
      7) Pre-acceptance Checklists.
      8) Notice of Acceptance.
      9) Settlement and Final Payment.
   b. Preparation of record documents.
   c. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
   d. Submittal of written warranties.
   e. Requirements for completing LEED documentation, for projects pursuing LEED certification.
   f. Requirements for preparing operations and maintenance data.
   g. Requirements for delivery of material samples, attic stock, and spare parts.
   h. Requirements for demonstration and training.
   i. University’s partial occupancy requirements.
   j. Installation of University’s furniture, fixtures, and equipment.
   k. Responsibility for removing temporary facilities and controls.

4. Minutes: Entity conducting meeting will record and distribute meeting minutes.
E. **Progress Meetings**: Conduct progress meetings at weekly intervals.

1. Coordinate dates of meetings with preparation of payment requests.
2. **Attendees**: Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work and include the following:
   
   a. University Project Manager.
   b. University Health Safety Department Representative.
   d. University Campus Building Official.
   e. Architect/Engineer and their consultants.
   f. Contractor’s project manager and superintendent.
   g. Major subcontractors and suppliers.
   h. Other entities concerned with current progress or involved in planning, coordination, or performance of future activities.
   i. As needed, University Building Maintenance Operations (BMO), Subject Matter Experts (SME), and University Facility Support Services (FSS) Representatives.

3. **Agenda**: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

   a. **Contractor's Construction Schedule**:
      
      1) Review progress since the last meeting.
      2) Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule.
      3) Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
      4) Review schedule for next two week period.
      5) Review schedule of deliveries.
      6) Review off-site fabrication.
   
   b. **Site Safety**.
   c. **Indoor Air Quality Management monitoring**.
   d. **MS4 Storm Water and Water Quality monitoring**.
   e. **Quality**:
      
      1) Quality and work standards.
      2) Status of correction of deficient items.
      3) Progress cleaning.
      4) Field observations.
   
   f. **Status of submittals**.
   g. **Status of RFI’s**.
   h. **Status of Changes including**:
      
      1) Change Order Bulletins.
      2) Change Order Proposals.
      3) Change Orders.
      4) Pending claims and disputes.
   
   i. **Status of LEED documentation**, for projects pursuing LEED certification.
j. Review present and future needs of each entity present including:

1) Access.
2) Site utilization.
3) Temporary facilities and controls.
4) Coordination.

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

F. Pay Application and Schedule Review Meeting: Conduct review meeting monthly on or about the 25th of each month.

1. Attendees:

   a. University Project Manager.
   b. Architect/Engineer.
   c. Contractor’s Project Manager, Superintendent and Scheduler.

2. Agenda: Review draft pay application and progress schedule update in accordance with the requirements of Section 01 29 00 “Payment Procedures” and Section 01 32 00 “Construction Progress Documentation.”

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 31 00
SECTION 01 32 00
CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1. Startup construction schedule.
2. Contractor's construction schedule.
3. Construction schedule updating reports.
4. Weekly project status reports.

B. Related Requirements:

1. Section 01 33 00 "Submittal Procedures" for submitting schedules and reports.
2. Section 01 40 00 "Quality Requirements" for submitting a schedule of tests and inspections.

1.3 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.

1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
2. Predecessor Activity: An activity that precedes another activity in the network.
3. Successor Activity: An activity that follows another activity in the network.
4. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

1.4 INFORMATIONAL SUBMITTALS

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

1. Working electronic copy of schedule file, where indicated.
2. PDF electronic file and four paper copies.

B. Startup construction schedule (bar chart).
1. Approval of cost-loaded, startup construction schedule will not constitute approval of schedule of values for cost-loaded activities.

1.5 QUALITY ASSURANCE

A. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00 "Project Management and Coordination." Review methods and procedures related to the preliminary construction schedule and Contractor's construction schedule, including, but not limited to, the following:

1. Review software limitations and content and format for reports.
2. Verify availability of qualified personnel needed to develop and update schedule.
3. Discuss constraints, including phasing, work stages, area separations, interim milestones, and partial University occupancy, as may be applicable.
4. Review delivery dates for University-furnished products.
5. Review schedule for work of University's separate contracts.
6. Review submittal requirements and procedures.
7. Review time required for review of submittals and resubmittals.
8. Review requirements for tests and inspections by independent testing and inspecting agencies.
9. Review time required for Project closeout and University startup procedures, including commissioning activities.
10. Review and finalize list of construction activities to be included in schedule.
11. Review procedures for updating schedule.

1.6 COORDINATION

A. Coordinate Contractor's construction schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from entities involved.
2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

A. Time Frame: Extend schedule from date established for commencement of the Work to date of Substantial Completion.

1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date is not permitted. Contract completion date may only be modified by Change Order.

B. Activities: Treat each story or separate area as a separate numbered activity for each main element of the Work. Comply with the following:

1. Activity Duration: Define activities so no activity is longer than 21 calendar days, unless specifically allowed by Architect/Engineer.
2. Procurement Activities: Include procurement process activities for long lead items and major items, requiring a cycle of more than 60 calendar days, as separate activities in schedule.
Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.

3. **Submittal Review Time:** Include review and resubmittal times indicated in Section 01 33 00 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.

4. **Startup and Testing Time:** Include adequate time for startup, testing and commissioning.

5. **Substantial Completion:** Indicate completion in advance of date established for Substantial Completion, and allow time for Architect/Engineer's administrative procedures necessary for issuing Notice of Substantial Completion.

C. **Constraints:** Include the following constraints and work restrictions as indicated in the Contract Documents and as applicable in schedule; show how the sequence of the Work is affected.

1. **Phasing:** Arrange list of activities on schedule by phase.
2. **Work by University:** Include a separate activity for each portion of the Work performed by University.
3. **Products Ordered in Advance:** Include a separate activity for each product. Include delivery date indicated in Section 01 10 00 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
4. **University-Furnished Products:** Include a separate activity for each product. Include delivery date indicated in Section 01 10 00 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
5. **Work Restrictions:** Show the effect of the following items, as applicable, on the schedule:
   a. Coordination with existing construction.
   b. Limitations of continued occupancies.
   c. Uninterruptible services.
   d. Partial occupancy before Substantial Completion.
   e. Use of premises restrictions.
   f. Environmental control.
6. **Work Stages:** Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
   a. Submittals.
   b. Mockups.
   c. Fabrication.
   d. Sample testing.
   e. Deliveries.
   f. Installation.
   g. Tests and inspections.
   h. Building flush-out.
   i. Startup and placement into final use and operation.
7. **Construction Areas:** As applicable, identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
   a. Structural completion.
   b. Temporary enclosure and space conditioning.
   c. Permanent space enclosure.
   d. Completion of mechanical installation.
   e. Completion of electrical installation.
   f. Substantial Completion.
D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Commencement of Work, Substantial Completion, Notice of Occupancy and Use, and Final Acceptance. As applicable, also include milestones for Partial Substantial Completion and Partial Notice of Occupancy and Use.

E. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and date by which recovery will be accomplished.

F. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules and as approved by University and Architect/Engineer.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE (BAR CHART OR GANTT CHART)

A. Bar-Chart or Gantt-Chart Schedule: Submit startup, horizontal, bar-chart-type or a comprehensive, fully developed, horizontal, Gantt-chart-type construction schedule within 30 calendar days of date established for commencement of the Work. Base schedule on the startup construction schedule and additional information received since the start of Project.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Use the same breakdown of construction activities as indicated in the Schedule of Values.

1. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar. With each required construction schedule update, place a contrasting mark in each bar to indicate actual completion.

2.3 REPORTS

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

1. List of subcontractors at Project site.
2. List of separate contractors at Project site.
3. Approximate count of personnel at Project site.
4. Equipment at Project site.
5. Material deliveries.
6. High and low temperatures and general weather conditions, including presence of rain or snow.
7. Accidents.
8. Meetings and significant decisions.
9. Unusual events (see special reports).
10. Stoppages, delays, shortages, and losses.
11. Meter readings and similar recordings.
13. Orders and requests of authorities having jurisdiction.
14. Change Orders received and implemented.
15. Services connected and disconnected.
16. Equipment or system tests and startups.
17. Partial completions and occupancies.
18. Substantial Completions authorized.
2.4 SPECIAL REPORTS

A. General: Submit special reports directly to University within one calendar day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.

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

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule draft update schedule for discussion and review at monthly project progress schedule and pay application review meeting.

1. Revise schedule immediately after each meeting and issue updated schedule concurrently with submittal of monthly Application for Payment.
2. Include summary reports with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
3. As the Work progresses, indicate final completion percentage for each activity.
4. Schedule updates may change logic but may not change milestone or critical path without prior approval of University and Architect/Engineer.

B. Distribution: Distribute copies of approved schedule to Architect/Engineer University, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.

1. Post copies in Project meeting rooms and temporary field offices.
2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION 01 32 00
SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

B. Related Requirements:

1. Section 01 29 00 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
2. Section 01 32 00 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
3. Section 01 78 23 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
4. Section 01 78 39 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
5. Division 02 through 33 for additional submittal requirements specific to indicated Specification Sections.

1.3 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Architect/Engineer's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals." Submittals not specifically indicated as informational submittals are considered to be action submittals.

B. Informational Submittals: Written and graphic information and physical samples that do not require Architect/Engineer's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals" and include, but are not limited to:

1. Schedules.
2. Permits.
3. Applications for payment.
4. Performance and payment bonds.
5. Insurance certificates.
7. Schedule of Values.
8. Inspection and test results.
10. Coordination drawings.
13. Anschutz Medical Campus Street Services Request.


1.4 ACTION SUBMITTALS

A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect/Engineer and additional time for handling and reviewing submittals required by those corrections.

1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
2. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.
   a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.
3. Format: Arrange the following information in a tabular format:
   a. Scheduled date for first submittal.
   b. Specification Section number and title.
   c. Submittal category: Action; informational.
   d. Name of subcontractor.
   e. Description of the Work covered.
   f. Scheduled date for resubmittal.
   g. Scheduled date for Architect/Engineer's final release or approval.
   h. Scheduled date of fabrication.

1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

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

1. Architect/Engineer will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings and Project record drawings.
   a. Architect/Engineer makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
   b. Digital Drawing Software Program: The Contract Drawings are available in Autocad.
   c. Contractor shall execute a data licensing agreement in the form of Agreement form acceptable to University and Architect/Engineer.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities. Transmit for review with sufficient time to avoid construction delays.
1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.

2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.

3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.

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

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

C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect/Engineer's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

   1. Initial Review: Allow 14 calendar days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect/Engineer will advise Contractor when a submittal being processed must be delayed for coordination.

   2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.

   3. Resubmittal Review: Allow 14 calendar days for review of each resubmittal.

   4. Large and/or Complex Submittals: For large and/or complex submittals, as determined by the Architect/Engineer and for submittals that require sequential reviews by Architect/Engineer’s consultants, a review period greater than 14 calendar days may be required. Architect/Engineer and Contractor shall identify such submittals upon submission of the submittal schedule and determine a mutually agreed upon review period.

D. Paper Submittals: Place a permanent label or title block on each submittal item for identification.

   1. Indicate name of firm or entity that prepared each submittal on label or title block.

   2. Provide a space approximately [6 by 8 inches] on label or beside title block to record Contractor's review and approval markings and action taken by Architect/Engineer.

   3. Include the following information for processing and recording action taken:

      a. Project name.
      b. Date.
      c. Name of Architect/Engineer.
      d. Name and address of Contractor.
      e. Name and address of subcontractor.
      f. Name and address of supplier.
      g. Name of manufacturer.
      h. Submittal number or other unique identifier, including revision identifier.

      1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 061000.01.A).

      i. Number and title of appropriate Specification Section.
      j. Drawing number and detail references, as appropriate.
      k. Location(s) where product is to be installed, as appropriate.
      l. Other necessary identification.
4. Additional Paper Copies: Unless additional copies are required for final submittal, and unless Architect/Engineer observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.
   a. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Architect/Engineer.

5. Transmittal for Paper Submittals: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect/Engineer will return without review submittals received from sources other than Contractor.
   a. Transmittal Form for Paper Submittals: Provide locations on form for the following information:
      1) Project name.
      2) Date.
      3) Destination (To:).
      4) Source (From:).
      5) Name and address of Architect/Engineer.
      6) Name and address of Contractor.
      7) Name of firm or entity that prepared submittal.
      8) Names of subcontractor, manufacturer, and supplier.
      9) Category and type of submittal.
     10) Submittal purpose and description.
     11) Specification Section number and title.
     12) Specification paragraph number or drawing designation and generic name for each of multiple items.
     13) Drawing number and detail references, as appropriate.
     14) Indication of full or partial submittal.
     15) Transmittal number.
     16) Submittal and transmittal distribution record.
     17) Remarks.
     18) Contractor's certification that information complies with Contract Document requirements.
     19) Signature of transmitter.

E. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:
   1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
   2. Name file with submittal number or other unique identifier, including revision identifier.
      a. File name shall use project identifier and Specification Section number followed by a dash and then a sequential number (e.g., LNHS-061000-01). Resubmittals shall include an alphabetic suffix after another dash (e.g., LNHS-061000-01-A).
   3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect/Engineer.

F. Options: Identify options requiring selection by Architect/Engineer.

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

H. Contractor Certification: On transmittal include Contractor's certification that information complies with Contract Document requirements.

I. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
   1. Note date and content of previous submittal.
   2. Note date and content of revision in label or title block and clearly indicate extent of revision.
   3. Resubmit submittals until they are marked with approval notation from Architect/Engineer's action stamp.

J. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

K. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect/Engineer's action stamp.

L. Record Documents: Retain complete additional copies of submittals on Project site to be submitted as record documents in accordance with requirements of Section 01 78 39 “Project Record Documents.”

M. Legibility: Provide clear and legible submittals. Submittals that are blurry or are for any reason unreadable will be returned without action.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
   1. Post electronic submittals as PDF electronic files directly to Architect’s email.

   2. Action Submittals: Submit three paper copies of each submittal to Architect/Engineer and one to University unless otherwise indicated. Architect/Engineer will return one copy.

   3. Informational Submittals: Submit two paper copies of each submittal to Architect/Engineer and one to University unless otherwise indicated. Architect/Engineer will not return copies.

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

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
   1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
   2. Mark each copy of each submittal to show which products and options are applicable.
   3. Include the following information, as applicable:
a. Manufacturer's catalog cuts.
b. Manufacturer's product specifications.
c. Manufacturer's installation instructions.
d. Manufacturer's printed recommendations.
e. Standard color charts.
f. Statement of compliance with specified referenced standards.
g. Statement of compliance with specified trade association standards.
h. Testing by recognized testing agency.
i. Application of testing agency labels and seals.
j. Notation of coordination requirements.
k. Notation of dimensions verified by field measurement.

4. For equipment, include the following in addition to the above, as applicable:
   a. Wiring diagrams showing factory-installed wiring.
   b. Printed performance curves.
   c. Operational range diagrams.
   d. Rough-in diagrams and templates indicating clearances required to other construction, if not indicated on accompanying Shop Drawings.

5. Submit Product Data before or concurrent with Samples.


7. Submit additional copies of Product Data as required complying with requirements of Section 01 78 39 “Project Record Documents.”

C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Highlight, encircle or otherwise indicate deviations from Contract Documents. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal based on Architect/Engineer's digital data drawing files is otherwise permitted. Standard information prepared without specific reference to the Project is not considered a shop drawing.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
   a. Identification of products.
   b. Schedules.
   c. Compliance with specified standards.
   d. Notation of coordination requirements.
   e. Notation of dimensions established by field measurement.
   f. Relationship and attachment to adjoining construction clearly indicated.
   g. Seal and signature of professional engineer if specified.

2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches, but no larger than size of Construction Drawings.

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

1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
2. Mount, display or package Samples in the manner specified to facilitate review of qualities indicated. Prepare Samples to match the Architect/Engineer's Sample.
3. Identification: Attach label on unexposed side of Samples that includes the following:
a. Generic description of Sample.
b. Product name and name of manufacturer.
c. Sample source.
d. Number and title of applicable Specification Section.
e. Specification paragraph number and generic name of each item.
f. Compliance with recognized standards.
g. Availability and delivery time.

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

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

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

6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

a. Number of Samples: Submit three sets of Samples. Architect/Engineer will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record sample.

1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.

2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

7. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.

a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.

b. Samples not incorporated into the Work, or otherwise designated as University's property, are the property of Contractor.

8. Distribution of Samples: Prepare and distribute additional sets to Subcontractors, manufacturers, fabricators, suppliers, Installers, and others as required for performance of the Work. Show distribution on transmittal forms.

9. Field Samples and Mock-Ups: Field Samples and mock-ups specified in individual Sections are full-size examples erected on site to illustrate finishes, coatings, or finish materials and to establish the standard by which the Work will be judged.

E. Selection of Related Materials: Where selections of colors, patterns, textures are specified to be made by Architect/Engineer, assemble complete samples of all specified or approved products for all Specification
Sections and submit to Architect/Engineer. Review specifications and assemble all such samples for a combined single submittal. Indicate on the transmittal the latest date for selections to be made for each item to permit delivery of material in accordance with Progress Schedule. Architect/Engineer's action is limited solely to the specified selections or rejection of submittal items not in accordance with Specifications.

F. Coordination Drawing Submittals: Comply with requirements specified in Section 01 31 00 "Project Management and Coordination."

G. Contractor's Construction Schedule: Comply with requirements specified in Section 01 32 00 "Construction Progress Documentation."

H. Application for Payment and Schedule of Values: Comply with requirements specified in Section 01 29 00 "Payment Procedures."

I. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 01 40 00 "Quality Requirements."

J. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 01 77 00 "Closeout Procedures."

K. Maintenance Data: Comply with requirements specified in Section 01 78 23 "Operation and Maintenance Data."

L. LEED Submittals: For project required to obtain LEED certification, comply with requirements specified in Division 01 Section "Sustainable Design Requirements."

M. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.

N. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.

O. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

P. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

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

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

S. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

T. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by
manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a
qualified testing agency.

U. Research Reports: Submit written evidence, from a model code organization acceptable to authorities
having jurisdiction, that product complies with building code in effect for Project. Include the following
information:

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

V. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's
standard form, indicating and interpreting results of tests performed before installation of product, for
compliance with performance requirements in the Contract Documents.

W. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's
standard form, indicating and interpreting results of compatibility tests performed before installation of
product. Include written recommendations for primers and substrate preparation needed for adhesion.

X. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed
either during installation of product or after product is installed in its final location, for compliance with
requirements in the Contract Documents.

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

2.2 DELEGATED-DESIGN SERVICES

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

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

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

1. Indicate that products and systems comply with performance and design criteria in the Contract
Documents. Include list of codes, loads, and other factors used in performing these services.
PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect/Engineer. Submittals received without Contractor’s substantive review and approval stamp will be rejected and returned to the Contractor.

B. Project Closeout and Maintenance Material Submittals: See requirements in Section 01 77 00 "Closeout Procedures."

C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor’s approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT/ENGINEER'S ACTION

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

B. Informational Submittals: Architect/Engineer will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect/Engineer will forward each submittal to appropriate party.

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

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

E. Submittals not required by the Contract Documents may be returned by the Architect/Engineer without action.

END OF SECTION 01 33 00
SECTION 01 35 44

SPECIAL PROCEDURES FOR ENVIRONMENTAL HEALTH AND SAFETY AND FIRE AND LIFE SAFETY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes special administrative and procedural requirements related to environmental health and safety.

B. University is Authority Having Jurisdiction (AHJ) for Fire and Life Safety. This responsibility is administered by the University’s Fire and Life Safety Officer.

C. Related Requirements:

1. Section 01 35 46 “Indoor Air Quality Procedures” for procedure related to maintaining indoor air quality during construction.

2. Section 02 81 00 “Transportation/Disposal of Hazardous Materials.”

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 ENVIRONMENTAL HEALTH AND SAFETY AND FIRE AND LIFE SAFETY PROCEDURES

A. Physical, Life, and Fire Safety:

1. All contractors are required to conform to the Federal Occupational Safety and Health Administration (OSHA) regulations for construction (29 CFR 1926). Certain General Industry Standards (29 CFR 1910) may also apply, depending on location of work.

2. Provide an effective health and safety program to control hazards, including but not limited to compressed gases, welding, electrical, safety netting, cranes, scaffolding and supplies on the roof.

3. Provide fire protection in all construction areas to the satisfaction of the Authority Having Jurisdiction.

4. During the construction phase, the Authority Having Jurisdiction may conduct oversight inspections to observe and provide recommendations regarding applicable safety standards. The following minimum items are included:

   a. Do not block exit corridors. Install signage clearly identifying exit routes.

   b. Provide physical barriers with appropriate warning signage to protect public areas from construction work.
c. Conduct daily inspections to eliminate fire hazards and any other safety hazards.
d. Periodic safety inspections will be performed on job sites by the Authority Having Jurisdiction. The Authority Having Jurisdiction for fire safety will present University’s Project Manager with a written summary of the findings who will then take these issues to the Contractor’s superintendent, foreman or other designated representative and return the summary form with documentation of the resolution of safety items to AHJ. Abate deficient items in a timely manner. Include documentation and resolution of safety items presented in weekly Progress Meeting minutes. Inspections by University AHJ are spot-checks only. They are not all encompassing. These inspections and recommendations do not relieve the Contractor from obligations related to safe work practices, as required under federal law.
e. AHJ has the right to access the site at all times. Should a potential threat to personnel or property be observed, AHJ may require the hazard related operation immediately altered until adequate safeguards are addressed.
f. Supply AHJ, through the University Project Manager, with a copy of Contractor’s weekly safety meeting minutes and safety inspection reports.
g. Provide signs used for proper identification of construction areas.
h. Provide adequate number of appropriately rated fire extinguishers to be available on-site for emergency use in the construction area.
i. Insure standpipes, pull stations, electrical panels, water control valves and fire hydrants are accessible at all times.
j. Post emergency notification phone numbers provided by Contractor and University in all construction areas.
k. Notify University Project Manager of any lost time injuries occurring on University’s property within one (1) calendar day and of any fatalities immediately.
l. Submit copies of all injury reports to AHJ, through University’s Project Manager.
m. Equip construction personnel with personal protective equipment (PPE) where required. Coordinate with University Project Manager to identify where use of PPE will be required.

B. OSHA Hazard Communication Standard:

1. Every Contractor and Subcontractor performing work shall to comply with the OSHA Hazard Communication Standard. Compliance includes joint University and Contractor responsibilities for the purpose of providing timely communications and information sharing with regard to hazardous materials, chemicals and chemical sources which may be present on-site or brought in by Contractor.
2. University Project Manager will provide Contractor with the following:
   a. Information regarding known hazardous chemicals and agents or other hazards present at the job site.
   b. University emergency procedures and contact numbers.
3. Provide safety training and environmental surveillance of all workers.
4. Inform and provide University’s Project Manager the following:
   a. Material safety data sheets (MSDS) for all chemicals introduced into the workplace.
   b. Information regarding potential sources of pollutants which may be entrained in University's air intakes, e.g., roofing tar fumes, nuisance dusts, exhaust from internal combustion engines, welding or cutting fumes, and asbestos - if damaged or encountered during the course of the work.

C. Asbestos and Lead Paint:

1. The presence of asbestos-containing materials and/or paint containing lead on the job site does not mean a problem exists. Areas where asbestos is friable and not contained or lead paint is present or will be caused to be present in airborne or settled dust are of concern.
2. Responsibilities of University and Contractor regarding asbestos and lead paint are as follows:

a. University:

1) Notify the Contractor of the condition and location(s) where asbestos is known to be present or may reasonably be encountered, e.g., asbestos insulation, ceiling tiles, floor tiles, fire doors, wall and ceiling plasters, concrete, grouting, etc., and lead paint on metal building materials, walls, windows, etc.

2) Coordinate with Contractor when response action is required by a Subcontractor.

3) Contract with third party contractor to monitor areas where friable asbestos and/or lead-containing particles are present during construction/renovation projects for its own records and purpose. Monitoring results can be shared with Contractors but are in no way to be used for Contractor employee monitoring.

4) Final authority on all asbestos-related concerns and contractual arrangements.

b. Contractor:

1) Notify University's Project Manager of any suspected or existing problem involving asbestos or lead and cease work in that area until University has assessed the situation.

2) Ensure that undamaged asbestos-containing material and/or material containing lead, not included in the scope of the project, are not damaged.

3) Train and monitor their own employees, including Asbestos Awareness training and Lead Paint Awareness training, where applicable.

4) Be responsible for all environmental/industrial hygiene surveillance of its work staff and subcontractors and for required area monitoring where potential contamination of adjacent areas exists.

5) Prevent problems which can result in asbestos or lead exposure to building occupants.

6) Coordinate with the University’s EHS Department and Building Maintenance and Operations through University’s Project Manager and perform all activities that may potentially disturb asbestos containing materials in a manner acceptable to the EHS.

7) Follow State of Colorado regulation, Emission Standards for Asbestos, Part B, Control of Asbestos, “Regulation 8” and OSHA standards regulating exposure to asbestos and lead.

8) Where applicable, comply with Section 02 81 00 “Transportation/Disposal of Hazardous Materials.”


D. Carcinogens:

1. Contractor or any Subcontractor shall not knowingly install or cause to be installed any material or product containing carcinogens. Refer to Annual Report on Carcinogens, U.S. Department of Health and Human Services, National toxicology Program.

E. Hazardous Waste:

1. All hazardous wastes are to be handled and disposed of according to current University EHS guidelines which can be obtained through University Project Manager. Only individuals specifically authorized by University may sign hazardous waste manifests for wastes generated on University’s property. Only University approved transporters and disposal facilities are to be used for transportation and disposal of hazardous wastes.
F. The Control of Hazardous Energy (Lockout/Tagout):
   1. Provide and enforce a program and procedures for the control of hazardous energy (lockout/tagout) including, but not limited to, locks, tags and lockout devices. Provide proof that workers have received safety training in the control of hazardous energy through lockout/tagout.

G. Hot Work Operations:
   1. Comply with University hot work policy and obtain Hot Work Permit prior to executing any hot work in existing buildings.
   2. Notify University Project Manager prior to any hot work on University property.
   3. Provide and enforce a program to control fires during hot work operations. Provide appropriately rated fire extinguishers, fire retardant protective covers (when needed), and any other hot work related equipment.

H. Confined Space Entry:
   1. Work in compliance with the “Confined Spaced Entry Procedure for Non-University Personnel” whenever any project requires entry into a confined space. A copy of this procedure can be obtained from University EHS through University’s Project Manager.

I. Green Tagging of Work Area:
   1. Obtain a Green Tag and Construction Permit from the University Project Manager prior to any work being conducted in a laboratory or on any exhaust ductwork system serving a laboratory. If a Green Tag has been issued, it will be displayed at the entry of the laboratory area. The Green Tag assures that any radioactive, chemical or biological materials have been removed from the laboratory verifying the area is free from hazards to workers. If a Green Tag is not displayed, coordinate tagging with EHS through University’s Project Manager.

END OF SECTION 01 35 44
SECTION 01 35 46

INDOOR AIR QUALITY PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for managing emissions and moisture control during construction.

1.3 DEFINITIONS

A. Sustainable Design Related Terminology: As defined in ASTM E 2114.

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

C. Hazardous Materials: Any material that is regulated as a hazardous material in accordance with 49 CFR 173, requires a Material Safety Data Sheet (MSDS) in accordance with 29 CFR 1910.1200, or which during end use, treatment, handling, storage, transportation or disposal meets or has components which meet or have the potential to meet the definition of a Hazardous Waste in accordance with 40 CFR 261. Throughout this specification, hazardous material includes hazardous chemicals.

1. Hazardous materials include: pesticides, biocides, and carcinogens as listed by recognized authorities, such as the Environmental Protection Agency (EPA) and the International Agency for Research on Cancer (IARC).

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

E. Interior Final Finishes: Materials and products that will be exposed at interior, occupied spaces including but not limited to flooring, wallcovering, finish carpentry, and ceilings.

F. Packaged Dry Products: Materials and products that are installed in dry form and are delivered to the site in manufacturer's packaging including but not limited to carpets, resilient flooring, ceiling tiles, and insulation.

G. Wet Products: Materials and products installed in wet form, including paints, sealants, adhesives, special coatings, and other materials which require curing.
1.4 QUALITY ASSURANCE

A. Inspection and Testing Lab Qualifications: Minimum of 5 years experience in performing the types of testing specified herein.

1.5 PRECONSTRUCTION MEETING

A. After award of Contract and prior to the commencement of the Work, schedule and conduct meeting with University and Architect/Engineer to review and discuss the proposed IAQ Management Plan and develop a mutual understanding of detailed requirements for maintaining indoor air quality and environmental protection.

1.6 SUBMITTALS

A. Indoor Air Quality (IAQ) Management Plan: Not less than 10 business days before the Pre-construction meeting, prepare and submit an IAQ Management Plan including, but not limited to, the following:

1. Procedures for control of emissions during construction.
   a. Identify schedule for application of interior finishes.

2. Procedures for moisture control during construction.
   a. Identify porous materials and absorptive materials.
   b. Identify schedule for inspection of stored and installed absorptive materials.

3. Revise and resubmit Plan as required by University.
   a. Approval of Contractor’s Plan will not relieve the Contractor of responsibility for compliance with applicable environmental regulations.

B. Product Data:

1. Submit product data for filtration media used during construction and during operation. Include Minimum Efficiency Reporting Value (MERV).
2. Submit air pressure difference maps for each mode of operation of HVAC.
3. Material Safety Data Sheets: Submit MSDSs for inclusion in Operation and Maintenance Manual for the following products. Coordinate with Section 01 78 23 – Operation and Maintenance Data.
   a. Adhesives.
   b. Floor and wall patching/leveling materials.
   c. Caulking and sealants.
   d. Insulating materials.
   e. Fireproofing and firestopping.
   f. Carpet.
   g. Paint.
   h. Clear finish for wood surfaces.
   i. Lubricants.
   j. Cleaning products.

C. Inspection and Test Reports:

1. Moisture control inspections.
2. Moisture content testing.
3. Moisture penetration testing.
4. Microbial growth testing.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 IAQ MANAGEMENT - EMISSIONS CONTROL

A. Provide point person responsible for the implementation and assurance that the Indoor Air Quality Plan is being implemented.

B. University Indoor Air Quality Plan: Comply with the requirements of the University IAQ Plan, latest version, appended to this Specification Section.

C. Flush-Out: After construction ends, prior to occupancy and with all interior finishes installed, perform a building flush-out by supplying a total air volume of 14,000 cu.ft. of outdoor air per sq.ft. of floor area while maintaining an internal temperature of at least 60 degrees F and relative humidity no higher than 60%.

3.2 IAQ MANAGEMENT - MOISTURE CONTROL

A. Housekeeping:

1. Keep materials dry. Protect stored on-site and installed absorptive materials from moisture damage.
2. Verify that installed materials and products are dry prior to sealing and weatherproofing the building envelope.
3. Install interior absorptive materials only after building envelope is sealed and weatherproofed.

B. Inspections: Document and report results of inspections; state whether or not inspections indicate satisfactory conditions.

1. Examine materials for dampness as they arrive. If acceptable to University, dry damp materials completely prior to installation; otherwise, reject materials that arrive damp.
2. Examine materials for mold as they arrive and reject materials that arrive contaminated with mold.
3. Inspect stored and installed absorptive materials regularly for dampness and mold growth. Inspect weekly.

   a. Where stored on-site or installed absorptive materials become wet, notify Architect/Engineer and University. Inspect for damage. If acceptable to University, dry completely prior to closing in assemblies; otherwise, remove and replace with new materials.

4. Basement: Monitor basement and crawlspace humidity, and dehumidify when relative humidity is greater than 85 percent for more than 2 weeks or at the first sign of mold growth.
5. Site drainage: Verify that final grades of site work and landscaping drain surface water and ground water away from the building.
6. Weather-proofing: Inspect moisture control materials as they are being installed. Include the following:
a. Air and weather-resistive barrier: Verify air and weather-resistive barrier is installed without punctures and/or other damage. Verify air barrier and weather-resistive is sealed completely.
b. Flashing: Verify correct shingling of the flashing for roof, walls, windows, doors, and other penetrations.
c. Insulation layer: Verify insulation is installed without voids.
d. Roofing: In accordance with ASTM D7186 Standard Practice for Quality Assurance Observation of Roof Construction and Repair

7. Plumbing: Verify satisfactory pressure test of pipes and drains is performed before closing in and insulating lines.
8. HVAC: Inspect HVAC system as specified in Section 23 08 00 – Commissioning.
   a. And, inspect HVAC to verify:
      1) Condensate pans are sloped and plumbed correctly.
      2) Access panels are installed to allow for inspection and cleaning of coils and ductwork downstream of coils.
      3) Ductwork and return plenums are air sealed.
      4) Duct insulation is installed and sealed.
      5) Chilled water line and refrigerant line insulation are installed and sealed.

C. Schedule:
   1. Schedule work such that absorptive materials, including but not limited to porous insulations, paper-faced gypsum board, ceiling tile, and finish flooring, are not installed until they can be protected from rain and construction-related water.
   2. Weather-proof as quickly as possible. Schedule installation of moisture-control materials, including but not limited to air and weather-resistive barriers, flashing, exterior sealants and roofing, at the earliest possible time.

D. Testing for Moisture Content: Test moisture content of porous materials and absorptive materials to ensure that they are dry before sealing them into an assembly. Document and report results of testing. Where tests are not satisfactory, dry materials and retest. If satisfactory results cannot be obtained with retest, remove and replace with new materials.
   1. Concrete: Moisture test prior to finish flooring application as specified in Division 09.
   2. Wood: Moisture test as per ASTM D4444 - Standard Test Methods for Use and Calibration of Hand-Held Moisture Meters; unless otherwise indicated acceptable upper limits for wood products are < 20% at center of piece; < 15% at surface.
   3. Gypsum Board, Gypsum Plaster, Insulation, and other absorptive materials: Moisture test with a Pinless Moisture Meter to assess patterns of moisture, if any.

E. Testing for Moisture Penetration:
   1. Windows: Test as per ASTM E1105 Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform or Cyclic Static Air Pressure Difference at 100 percent static-air-pressure difference specified in applicable Division 08 Sections; unless otherwise indicated, acceptable upper limits are no leakage for 15 minutes.
      a. Number of Tests: 1 percent of openings but not less than two.
2. Horizontal Waterproofing (not roofing): Test as per ASTM D5957 Standard Guide for Flood Testing Horizontal Waterproofing Installations; acceptable upper limits are no leakage for 15 minutes.
   a. Test frequency: 100 percent of horizontal waterproofed surfaces.

3. Masonry: Test as per ASTM C1601 Standard Test Method for Field Determination of Water Penetration of Masonry Wall Surfaces; acceptable upper limits are no leakage for 15 minutes.

4. Exterior Walls:
   a. Air tightness of the enclosure test: ASTM E779 Standard Test Method for Determining Air Leakage Rate by Fan Pressurization or ASTM E1827
      1) Air Leakage: The mean value of the air leakage flow rate calculated from measured data at 0.3 in wg (75 Pa) must not exceed 0.25 cu ft/ minute per square foot of envelope area. Measurements must be referenced at standard conditions of 14.696 psi (101.325 KPa) and 68 deg F.

F. Testing for Support of Microbial Growth: Test and report in accordance with ASTM D6329 Standard Guide for Developing Methodology for Evaluating the Ability of Indoor Materials to Support Microbial Growth Using Static Environmental Chambers. Indicate susceptibility of product or material to colonization and amplification of microorganisms. Identify microorganisms and conditions of testing.

1. Normal conditions: Perform testing at 35 degrees Centigrade and 50 percent relative humidity.
2. Extreme conditions: Perform worst case scenarios screening tests by providing an atmosphere where environmental conditions may be favorable for microbial growth.
3. Perform testing for the following:
   a. Fireproofing material on appropriate substrate.
   b. Ceiling tile.
   c. Wall covering.
   d. Other appropriate material.

END OF SECTION 01 35 46
Indoor Air Quality Plan
March 1, 2012

This plan describes the measures to be taken to provide good indoor air quality (IAQ) during construction and after
construction is complete and the occupants have moved into the building. This plan is based on the SMACNA standard
“IAQ Guidelines for Occupied Buildings under Construction” and the requirements of the LEED.

It is not the intent of this document to replace or supersede OSHA regulations as to safe construction workplace
practices. It remains the responsibility of the Construction Manager and the individual sub-contractors to maintain safe
building and site operations. Addition precautions may be necessary when hazardous materials are present.

The plan will address construction IAQ by recommending procedures in five areas of concern, which in turn will allow
the building to achieve two LEED program points:

- HVAC system protection
- Containment source control
- Pathway interruption
- Housekeeping
- Scheduling

The following describes the specific measures to be performed in each area of concern:

1. HVAC Protection

- During construction, provide MERV 13 filters for supply air intake when in use. Provide MERV 8 filters at the return air system openings when in use. Perform frequent maintenance when the HVAC system is being utilized and replace filters as they become loaded, prior to building flushout, and prior to occupancy.
- When performing construction activities that produce dust, such as drywall sanding, concrete cutting, masonry work, wood sawing or adding insulation, seal off the supply diffusers and return air system openings completely for the duration of the task.
- Shut down and seal off the supply diffusers and return air ducts during any demolition operations.
- Whenever the HVAC system is not used during construction, seal off the supply diffusers and return air system openings to prevent the accumulation of dust and debris in the duct system.
- Do not use the mechanical rooms to store construction or waste materials. Keep rooms clean and neat.
- Provide periodic duct inspections during construction; if the ducts become contaminated due to inadequate protection, clean the ducts professionally in accordance with NADCA (National Air Duct Cleaning Association) standards.
- The General Contractor shall take photographs showing measures in place.

2. Source Control

- Use low VOC products as indicated by the specifications to reduce potential problems.
Restrict traffic volume and prohibit idling of motor vehicles where emissions could be drawn into the building.

Utilize electric or natural gas alternatives for gasoline and diesel equipment where possible and practical. Use low-sulfur diesel in lieu of regular diesel.

Cycle equipment off when not being used or needed.

Exhaust pollution sources to the outside with portable fan systems. Prevent exhaust from recirculating back into the building from construction equipment outside the building.

Keep containers of wet products closed as much as possible. Cover or seal containers of waste materials that can release odor or dust.

Protect stored on-site or installed absorptive building materials from weather and moisture; wrap with plastic and seal tight to prevent moisture absorption.

The General Contractor shall take photographs showing measures in place.

3. Pathway Interruption

- Provide dust curtains or temporary enclosures to prevent dust from migrating to other areas when applicable.
- Locate pollutant sources as far away as possible from supply ducts and areas occupied by workers when feasible. Supply and exhaust systems may have to be shut down or isolated during such activity.
- During construction, isolate areas of work to prevent contamination of clean or occupied areas. Pressure differentials may be utilized to prevent contaminated air from entering clean areas.
- Depending on weather, ventilation using 100% outside air will be used to exhaust contaminated air directly to the outside during installation of VOC emitting materials.

4. Housekeeping

- Provide regular cleaning concentrating on HVAC equipment and building spaces to remove contaminants from the building prior to occupancy.
- All coils, air filters, fans and ductwork shall remain clean during installation and, if required, will be cleaned prior to performing the testing, adjusting and balancing of the systems.
- Suppress and minimize dust with wetting agents or sweeping compounds. Utilize efficient and effective dust collecting methods such as a damp cloth, wet mop, or vacuum with particulate filters, or wet scrubber.
- Remove accumulations of water inside the building. Protect porous materials such as insulation and ceiling tile from exposure to moisture.
- Thoroughly clean all interior surfaces prior to replacing filters and running HVAC system for system balancing, commissioning and building flushout.
- Provide photographs of the above activities during construction to document compliance.

5. Scheduling and Construction Activity Sequence

- Schedule high pollution activities that utilize high VOC level products (including paints, sealers, insulation, adhesives, caulking and cleaners) to take place prior to installing highly absorbent materials (such as ceiling tiles, gypsum wall board, fabric furnishing, carpet and insulation, for example). These materials will act as ‘sinks’ for VOCs, odors and other contaminants, and release them later after occupancy.

PLANNING AND INSPECTION CHECKLISTS

The planning and inspection checklists included in this document are useful to ensure construction IAQ management is planned and implemented correctly. The planning checklist should be completed by the contractor prior to construction. The inspection checklists should be completed monthly to confirm the IAQ management plan is being followed. At the
time of inspection, photographs should be taken to support the checklist and to provide audit documentation for the USGBC.
University of Colorado Denver IAQ
February 14, 2009

Planning Checklist
(Must be completed weekly)

Project _________________________________________________________________
Completed by: _________________________________________________________________
(Name & Company)
Date: ________________________________

1. HVAC Protection
   MERV 13 filters at supply air intake
   MERV 8 filters at return air openings
   Seal supply diffusers and return air during demolition
   Seal supply diffusers and return air openings during construction
   Mechanical rooms clean and neat
   Periodic duct inspections during construction
   General Contractor to document with photographs

2. Source Control
   Low/no VOC products as indicated by specifications
   Restrict vehicle traffic volume and prohibit idling
   Utilize electric or natural gas alternatives for gasoline and diesel
   Cycle equipment off when not being used or needed
   Exhaust pollution sources to the outside
   Keep containers of wet products closed
   Cover or seal containers of waste materials
   Protect absorptive building materials from weather and moisture
   Prevent fume migration from construction vehicles and equipment into adjacent buildings
   General Contractor to document with photographs

3. Pathway Interruption
   Provide dust curtains or temporary enclosures
   Locate pollutant sources as far away as possible from supply dusts and areas occupied by workers
   General Contractor to document with photographs
   Isolate areas of work to prevent contamination of clean or occupied areas
   When using VOC emitting materials ventilate using 100% outside air
4. **Housekeeping**

   Provide regular cleaning, including HVAC equipment

   If necessary clean HVAC equipment prior to testing, adjusting and balancing the systems

   Suppress and minimize dust with wetting agents or sweeping compounds

   Remove accumulations of water inside the building

   Protect porous materials

   General Contractor to document with photographs

5. **Scheduling and Construction Activity Sequence**

   Schedule high pollution activities prior to installing absorbent materials

   General Contractor to document with photographs

---

I confirm the checked activities to be proceeding according to the Construction Indoor Air Quality Plan. Items that are not checked will be addressed, initialed and dated once corrective actions have been taken. Items that are not applicable are labeled as such.

Signed: ________________________________ Date: ________________

(Contractor)
University of Colorado Denver IAQ
February 14, 2009

Inspection Checklist
(Must be completed weekly)

Project _________________________________________________________________
Completed by: _________________________________________________________________
(Name & Company)
Date: ________________________________

1. HVAC Protection
   MERV 13 filters at supply air intake
   MERV 8 filters at return air openings
   Seal supply diffusers and return air during demolition
   Seal supply diffusers and return air openings during construction
   Mechanical rooms clean and neat
   Periodic duct inspections during construction
   General Contractor to document with photographs

2. Source Control
   Low/no VOC products as indicated by specifications
   Restrict vehicle traffic volume and prohibit idling
   Utilize electric or natural gas alternatives for gasoline and diesel
   Cycle equipment off when not being used or needed
   Exhaust pollution sources to the outside
   Keep containers of wet products closed
   Cover or seal containers of waste materials
   Protect absorptive building materials from weather and moisture
   General Contractor to document with photographs

3. Pathway Interruption
   Provide dust curtains or temporary enclosures
   Locate pollutant sources as far away as possible from supply dusts and areas occupied by workers
   General Contractor to document with photographs
   Isolate areas of work to prevent contamination of clean or occupied areas
   When using VOC emitting materials ventilate using 100% outside air
   General Contractor to document with photographs
4. **Housekeeping**
   
   Provide regular cleaning, including HVAC equipment
   If necessary clean HVAC equipment prior to testing, adjusting and balancing the systems
   Suppress and minimize dust with wetting agents or sweeping compounds
   Remove accumulations of water inside the building
   Protect porous materials
   General Contractor to document with photographs

5. **Scheduling and Construction Activity Sequence**
   
   Schedule high pollution activities prior to installing absorbent materials
   General Contractor to document with photographs

I confirm the checked activities to be proceeding according to the Construction Indoor Air Quality Plan. Items that are not checked will be addressed, initialed and dated once corrective actions have been taken. Items that are not applicable are labeled as such.

Signed: ___________________________ Date: ________________

(Contractor)
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

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

1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.

2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.

3. Requirements for Contractor to provide quality-assurance and -control services required by Architect/Engineer, University, or authorities having jurisdiction are not limited by provisions of this Section.

4. Specific test and inspection requirements are not specified in this Section.

C. Related Requirements:

1. Section 01 42 00 "Reference" for list of references, standards and definitions.

2. Section 01 91 13 "General Commissioning" for coordination of testing with commissioning activities.

3. Division 23 for testing, adjusting and balancing of mechanical systems.

4. Division 26 for testing of electrical systems.

1.3 DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect/Engineer.

C. Mockups: Full-size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and, where indicated, qualities
of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.

1. As indicated in individual Specifications Sections or on the Drawings, the Work may include the following types of mockups:
   a. Laboratory Mockups: Full-size physical assemblies constructed at testing facility to verify performance characteristics.
   b. Integrated Exterior Mockups: Mockups of the exterior envelope erected separately from the building but on Project site, consisting of multiple products, assemblies, and subassemblies.
   c. Room Mockups: Mockups of typical interior spaces complete with wall, floor, and ceiling finishes, doors, windows, millwork, casework, specialties, furnishings and equipment, and lighting.

D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.

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

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

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

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

I. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.

1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).

J. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.4 CONFLICTING REQUIREMENTS

A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect/Engineer for a decision before proceeding.
B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect/Engineer for a decision before proceeding.

1.5 ACTION SUBMITTALS

A. Shop Drawings: Provide plans, sections, and elevations, indicating materials and size of construction.

1. Indicate manufacturer and model number of individual components.
2. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

1.6 INFORMATIONAL SUBMITTALS

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

1. Seismic-force-resisting system, designated seismic system, or component listed in the designated seismic system quality-assurance plan prepared by Architect/Engineer.

B. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

C. Schedule of Tests and Inspections: Prepare in tabular form and include the following:

1. Specification Section number and title.
2. Entity responsible for performing tests and inspections.
3. Description of test and inspection.
4. Identification of applicable standards.
5. Identification of test and inspection methods.
6. Number of tests and inspections required.
7. Time schedule or time span for tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

1.7 REPORTS AND DOCUMENTS

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

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

B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
   1. Name, address, and telephone number of technical representative making report.
   2. Statement on condition of substrates and their acceptability for installation of product.
   3. Statement that products at Project site comply with requirements.
   4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
   5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
   6. Statement whether conditions, products, and installation will affect warranty.
   7. Other required items indicated in individual Specification Sections.

C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
   1. Name, address, and telephone number of factory-authorized service representative making report.
   2. Statement that equipment complies with requirements.
   3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
   4. Statement whether conditions, products, and installation will affect warranty.
   5. Other required items indicated in individual Specification Sections.

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

1.8 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
   1. Monitor quality control over products, services, site conditions, and workmanship to produce work of specified quality.
   2. Comply fully with manufacturers' instructions, including each step in sequence.
   3. If manufacturers' instructions conflict with Contract Document requirements, request clarification from Architect/Engineer before proceeding.
   4. Comply with specified standards as a minimum quality for the work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
   5. Perform work by persons qualified to produce workmanship of specified quality.
B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

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

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

1. For all trades: Proof of applicable licensing.
2. Electrical contractors:

3. Plumbing Contractors:
   c. Gas piping installations: State of Colorado master plumber with minimum 5 years institutional or heavy commercial gas piping experience. Provide an on-site supervisor with a minimum of 3 years of supervisory experience.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.

F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.

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

G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329 or ASTM D 3740 as appropriate; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.
4. Authorized to operate in the State of Colorado.
5. Calibrate testing equipment at reasonable intervals with devices of accuracy traceable to National Bureau of Standards or of accepted values of natural physical constants.

H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:

1. Contractor responsibilities include the following:
   a. Provide test specimens representative of proposed products and construction.
   b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
   c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
   d. When required, build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
   e. When required, build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
   f. When testing is complete, remove test specimens, assemblies, mockups, and laboratory mockups, as applicable; do not reuse products on Project.

2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect/Engineer, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

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

1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect/Engineer.
2. Notify Architect/Engineer seven calendar days in advance of dates and times when mockups will be constructed.
3. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed during the construction at Project.
4. Demonstrate the proposed range of aesthetic effects and workmanship.
5. Obtain Architect/Engineer's approval of mockups before starting work, fabrication, or construction.
   a. Allow seven calendar days for initial review and each re-review of each mockup.
6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
7. Demolish and remove mockups when directed unless otherwise indicated.

L. Integrated Exterior Mockups: When indicated on Drawings, construct integrated exterior mockup. Coordinate installation of exterior envelope materials and products for which mockups are required in individual Specification Sections, along with supporting materials.

M. Room Mockups: When indicated on Drawings, construct room mockups incorporating required materials and assemblies, finished according to requirements. Provide required lighting and additional lighting where required to enable Architect/Engineer to evaluate quality of the Work. Provide room mockups of the following rooms:
N. Laboratory Mockups: When required by individual Specification Sections, comply with requirements of preconstruction testing and those specified in individual Specification Sections.

1.9 QUALITY CONTROL

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

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

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

1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
   a. Contractor shall not employ same entity engaged by University, unless agreed to in writing by University.
3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
5. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 01 33 00 "Submittal Procedures."

D. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

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

1. Notify Architect/Engineer and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.

2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.

3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.

4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.

5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.

6. Do not perform any duties of Contractor.

G. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.

2. Incidental labor and facilities necessary to facilitate tests and inspections.

3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.

4. Facilities for storage and field curing of test samples including, but not limited to, safe storage and proper curing of concrete test cylinders at Project site for first 24 hours after casting as required by ASTM C 31.

5. Delivery of samples to testing agencies.

6. Preliminary design mix proposed for use for material mixes that require control by testing agency.

7. Security and protection for samples and for testing and inspecting equipment at Project site.

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

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

I. Manufactured Items and Equipment: Where manufactured products or equipment are required to have representative samples tested, do not use such materials or equipment until tests have been made and the materials or equipment found to be acceptable. Do not incorporate in the work any product which becomes unfit for use after acceptance.

J. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Coordinate and submit concurrently with Contractor’s construction schedule. Update as the Work progresses.

1. Distribution: Distribute schedule to University, Architect/Engineer, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.10 SPECIAL TESTS AND INSPECTIONS

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

1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviews the completeness and adequacy of those procedures to perform the Work.
2. Notifying Architect/Engineer and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.

3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect/Engineer with copy to Contractor and to authorities having jurisdiction.

4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.

5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.

6. Retesting and reinspecting corrected work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections including instructions received from University. Include the following:

1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Architect/Engineer.
4. Identification of testing agency or special inspector conducting test or inspection.
5. Disposition: Pass, fail, nature of defects, if any.
6. Date and descriptions of remedial or correction action taken.

B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect/Engineer's reference during normal working hours.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 01 73 00 "Execution."

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

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

3.3 SCHEDULE OF INSPECTIONS AND TESTS BY UNIVERSITY

A. University will engage testing agency and pay for testing and inspection associated with the following materials and systems, where included in the Project:

1. Compaction density of fill and backfill.
2. Drilled pier end bearing conditions and depths.
4. Precast concrete.
5. Post-tensioned concrete tendons.
7. Structural steel field welds and bolted connections.
8. Spray-applied fireproofing.
10. Asphalitic concrete paving.
11. Foundation drainage systems.
12. Drainage structures and piping.
15. Fluid applied membranes.
16. Thermal imaging.
17. Curtain wall, window, and door field testing.
18. Ceiling hanger wire pull-out.
20. Field sound testing of operable partitions.
22. Fan vibration.

END OF SECTION 01 40 00
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Building Department Authority.
2. MS 4 Storm Water and Water Quality Permits
3. Applicable Codes and Standards.

1.3 BUILDING DEPARTMENT AUTHORITY

A. The University of Colorado Denver is charged with the responsibility of ensuring that provision of applicable codes, standards and guidelines are met on its campuses.

B. The University Denver campus has an established Building Authority responsible to review and examine buildings and plan documents, to permit and inspect construction and/or demolition to ensure conformance to codes adopted by the University and issue certificates of temporary occupancy and occupancy if satisfactory conformance is demonstrated.

C. The authority is executed by the Campus Building Official (CBO) who has the responsibility to perform all the duties set forth in the Current Approved State Buildings Codes and other applicable codes and standards indicated in the “Applicable Codes and Standards” Article of this Section.

D. Permits: Obtain a separate permit for each Project from the Office of the CBO prior to erecting, constructing, enlarging, repairing, moving, removing, converting or demolishing any building or portion thereof. Coordinate and obtain all permits through the University Project Manager. The Contractor is not responsible for costs associated with construction permits.

1. Exempt work: A building permit is not required for the following:

   a. Fences less than or equal to 6 feet tall.
   b. Movable casework, counters and partitions not over 5 feet 9 inches tall with no electrical or plumbing.
   c. Platforms, walks, and driveways not more than 30 inches above grade and not over any basement or story below.
   d. Painting, papering and similar finish work.
   e. Other work of limited scope at the discretion of the CBO.

E. Permit Issuance: The CBO, or at the discretion of the CBO a third party code consultant, will review application, Drawings, Specifications, computations and other data filed for permit. Complete the permit...
application with the University Project Manager. Permits require submittal of two (2) stamped, signed sets of Construction Documents, including Drawings, Specifications and all Addenda, and one (1) set of each engineering discipline’s calculations, where such calculations are required. If CBO determines that submittal conforms to the requirements of the Building Code and other applicable codes, standards, laws, regulations and ordinances, an inspection record card will be issued with the building permit. Keep one stamped set of documents on site. The University will keep one stamped set in the Campus Support plan room.

F. Suspension or Revocation of Permit: CBO may, in writing, suspend or revoke a permit issued in error or on the basis of submitted information that is incorrect or that is in violation of the Building Code and other applicable codes and standards.

G. Posting of Permit: Post the Permit in a visible and protected location near the access to the project.

H. Inspection Record Card: Post the Inspection Record Card next to the permit in a visible and protected location near the access to the project. CBO will make required entries based on inspection of the work.

I. Inspection Requests:
   1. Notify CBO that work is ready for inspection two business days before such inspection is desired by telephoning the number posted on the permit. The CBO retains the right to require requests in writing.
   2. A re-inspection fee may be charged for prior rejected items.

J. Construction Inspections:
   1. Contractor is not responsible for costs associated with construction inspections, except re-inspections. The CBO or his/her designee will perform all general building, electrical and plumbing inspections. All construction or work for which a permit is required must remain accessible and exposed for inspection purposes. Provide access to and means for inspection of work.
   2. Site Utilities: Contact and comply with all requirements of City of Aurora.
   3. Plumbing and Electrical Inspections: For new buildings and major additions, contact and comply with all requirements of State of Colorado Plumbing and Electrical Boards.
   4. Provisions for structural and other special inspections required by Contract Documents, current approved State Building Codes and University Codes will be provided by the University.

K. Certification of Occupancy:
   1. When CBO inspects the project and finds no violations of any provision of the Building Code, other applicable codes, standards, laws, regulations and ordinances, CBO will issue a Certification of Occupancy (CO) which will contain the following:
      a. Building permit number.
      b. Address of building.
      c. Name and address of Owner.
      d. Description of building or portion thereof for which certification is issued.
      e. Statement that described building or portion thereof has been inspected for compliance with the requirements of the Building Code, other applicable codes, standards, laws, regulations and ordinances, as relates to type of occupancy and use for which the building is intended.
2. Temporary Certificate of Occupancy (TCO): If CBO finds no substantial hazard will result from occupancy of any building or portion thereof before the same is completed, CBO may issue a TCO for the use of a portion or portions of a building or structure prior to the completion of the entire building or structure.

3. Posting of CO: Provide a copy to the University Project Manager and post in a conspicuous location on the premises. CO may not be removed except by CBO upon initial occupancy.

4. Revocation of CO:

1.4 MS4 STORM WATER AND WATER QUALITY PERMITS

A. The University has a non-standard MS4 permit for entire Anschutz Medical Campus (AMC) that requires University over-sight of campus construction and its water quality impact. Contractors are required to prepare Storm Water Quality Plans and obtain State of Colorado CDPHE permits for all projects that impact site. In addition, Contractors shall comply with the University MS4 permit requirements, including keeping written record of weekly inspections of Storm Water Quality measures and attaching record to the weekly Progress Meeting minutes. Submit the plan, permits, and evidence of final closeout to University Project Manager who will copy all such storm water documents to University Engineering Department. Coordinate with University Project Manager who will arrange for University Grounds Manager to attend monthly inspections and closeout walk.

1.5 APPLICABLE CODES AND STANDARDS

A. The following approved building codes and standards have been adopted by State Buildings Programs (SBP) as the minimum requirements to be applied to all state-owned buildings and physical facilities including capital construction and controlled maintenance construction projects. Current applicable codes can be obtained from The Office of the State Architect’s website.

B. University of Colorado Denver Codes and Standards: The following codes and standards supplement those indicated on the Office of the State Architect website.


   a. Use the most restrictive interpretation where NFPA 101 conflicts with the IBC requirements.


19. OSHA “Occupational Safety and Health Standards” (29 CRF 1910).
21. CDC-NIH Biosafety in Microbiological and Biomedical Laboratories (BMBL); latest edition.


C. Other Standards: As indicated in individual Specification Sections.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 41 00
SECTION 01 42 00

REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Definitions.
   2. Industry Standards.
   3. Abbreviations and Acronyms.

B. Related Requirements:
   1. Section 01 10 00 “Summary” for an explanation of specification and drawing conventions.
   2. Section 01 41 00 “Regulatory Requirements” for a list of applicable codes.

1.3 DEFINITIONS

A. General: Basic Contract definitions are included in the Conditions of the Contract.
   1. Definitions in this Section are not intended to be complete, exhaustive or exclusive. They are general and apply to the Work to the extent that such definitions are not stated more explicitly in other provisions of the Contract Documents.

B. “Approved”: When used to convey Architect/Engineer's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect/Engineer's duties and responsibilities as stated in the Conditions of the Contract. Except where expressly indicated, such approval does not release the Contractor from responsibility to fulfill requirements of the Contract Documents.

C. “Backup”: N+1 system.

D. "Directed": A command or instruction by Architect/Engineer. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."

E. “EHS”: Environmental Health and Safety.

F. “Engineer”: Architect/Engineer. Other terms including “Mechanical Engineer”, “Electrical Engineer”, or “Structural Engineer” have the same meaning as “Engineer.”

G. “General Conditions”: Contract terms contained in Contractor’s Agreement Design/Bid/Build, State Form SC-6.21 and The General Conditions of the Construction Contract Design/Bid/Build, State Form SC-6.23
H. “General Requirements”: Provisions and requirements of all Division 01 Sections as they apply to all aspects of the Work.

I. “Guarantee”: The narrow definition of the term “warranty” applying to both “warranty” and “guarantee” which terms are used interchangeably.

J. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."

K. “Redundant”: 2N system. The level of redundancy is determined by design.

L. "Regulations": 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.

M. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

N. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

O. “Owner”: Principal Representative and/or University.

P. "Provide": Furnish and install, complete and ready for the intended use.

Q. “Project Manual”: Bound, printed volume or volumes including Conditions of the Contract and Specifications, which may also include bidding requirements, contract forms, details, schedules, surveys, reports or other relevant items that may or may not be Contract Documents.

R. "Project Site": Space available for performing construction activities, either exclusively or in conjunction with others performing other work as part of the Project. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

S. “Supplementary Conditions”: University Special Supplementary General Conditions. Other terms including “Supplementary General Conditions” shall have the same meaning.

1.4 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

1. Referenced standards take precedence over standards that are not referenced but generally recognized in the construction industry as applicable.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents.

1. Updated Codes and Standards: Where an applicable code or standard has been revised and reissued after the date of the Contract Documents and before performance of Work affected, submit Contractor-Initiated Change Order Bulletin and Change Order Proposal in accordance with
Section 01 26 00 “Contract Modification Procedures” for consideration to modify contract requirements to comply with revised code or standard.

C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.
2. Where required by individual Specification Sections provide and maintain copies of referenced codes and standards at Project Site.
3. Although copies of standards needed for enforcement of requirements may be part of required submittals, the Architect/Engineer reserves the right to require the Contractor to submit additional copies as necessary for enforcement of requirements.

D. Unreferenced Standards: Unreferenced standards are not directly applicable to the Work, except as a general requirement of whether the Work complies with recognized construction industry standards.

E. Conflicting Requirements: Where compliance with two or more standards is specified, and they establish different or conflicting requirements for minimum quantities or quality levels, the most stringent requirement will be enforced, unless the Contract Documents indicate otherwise. Refer requirements that are different, but apparently equal, and uncertainties as to which quality level is more stringent to the Architect/Engineer for a decision before proceeding.

1.5 ABBREVIATIONS AND ACRONYMS

A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

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<tr>
<th>Acronym</th>
<th>Name</th>
<th>Phone</th>
<th>Web Site</th>
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<tbody>
<tr>
<td>AABC</td>
<td>Associated Air Balance Council</td>
<td>(202) 737-0202</td>
<td><a href="http://www.aabc.com">www.aabc.com</a></td>
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<tr>
<td>AAMA</td>
<td>American Architectural Manufacturers Association</td>
<td>(847) 303-5664</td>
<td><a href="http://www.aamanet.org">www.aamanet.org</a></td>
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<tr>
<td>AASHTO</td>
<td>American Association of State Highway and Transportation Officials</td>
<td>(202) 624-5800</td>
<td><a href="http://www.transportation.org">www.transportation.org</a></td>
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<tr>
<td>AATCC</td>
<td>American Association of Textile Chemists and Colorists</td>
<td>(919) 549-8141</td>
<td><a href="http://www.aatcc.org">www.aatcc.org</a></td>
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<tr>
<td>ABMA</td>
<td>American Bearing Manufacturers Association</td>
<td>(202) 367-1155</td>
<td><a href="http://www.americanbearings.org">www.americanbearings.org</a></td>
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<td>ACI</td>
<td>American Concrete Institute</td>
<td>(248) 848-3700</td>
<td><a href="http://www.concrete.org">www.concrete.org</a></td>
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<td>ACPA</td>
<td>American Concrete Pipe Association</td>
<td>(972) 506-7216</td>
<td><a href="http://www.concrete-pipe.org">www.concrete-pipe.org</a></td>
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<tr>
<td>AEIC</td>
<td>Association of Edison Illuminating Companies, Inc. (The)</td>
<td>(205) 257-2530</td>
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AF&PA  American Forest & Paper Association  (800) 878-8878
www.afandpa.org  (202) 463-2700

AGA  American Gas Association  (202) 824-7000
www.agasc.org

AHAM  Association of Home Appliance Manufacturers  (202) 872-5955
www.aham.org

AHRI  Air-Conditioning, Heating, and Refrigeration Institute (The)  (703) 524-8800
www.ahrinet.org

AI  Asphalt Institute  (859) 288-4960
www.asphaltinstitute.org

AIA  American Institute of Architects (The)  (800) 242-3837
www.aia.org  (202) 626-7300

AISC  American Institute of Steel Construction  (800) 644-2400
www.aisc.org  (312) 670-2400

AISI  American Iron and Steel Institute  (202) 452-7100
www.steel.org

AITC  American Institute of Timber Construction  (303) 792-9559
www.aitc-glulam.org

AMCA  Air Movement and Control Association International, Inc.  (847) 394-0150
www.amca.org

ANSI  American National Standards Institute  (202) 293-8020
www.ansi.org

AOSA  Association of Official Seed Analysts, Inc.  (607) 256-3313
www.aosaseed.com

APA  APA - The Engineered Wood Association  (253) 565-6600
www.apawood.org

APA  Architectural Precast Association  (239) 454-6989
www.archprecast.org

API  American Petroleum Institute  (202) 682-8000
www.api.org

ARI  Air-Conditioning & Refrigeration Institute
(See AHRI)

ARI  American Refrigeration Institute
(See AHRI)

ARMA  Asphalt Roofing Manufacturers Association  (202) 207-0917
www.asphaltroofing.org
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<td>BIFMA</td>
<td>BIFMA International (Business and Institutional Furniture Manufacturer's Association)</td>
<td>(616) 285-3963</td>
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<td><a href="http://www.bifma.com">www.bifma.com</a></td>
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<tr>
<td>BISSC</td>
<td>Baking Industry Sanitation Standards Committee</td>
<td>(866) 342-4772</td>
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<td><a href="http://www.bissc.org">www.bissc.org</a></td>
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<td>BOCA</td>
<td>BOCA (Building Officials and Code Administrators International Inc.)</td>
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<td>(See ICC)</td>
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<td>BWF</td>
<td>Badminton World Federation (Formerly: International Badminton Federation)</td>
<td>603 9283 7155</td>
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<td><a href="http://www.bwfbadminton.org">www.bwfbadminton.org</a></td>
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<tr>
<td>CDA</td>
<td>Copper Development Association</td>
<td>(800) 232-3282</td>
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<td><a href="http://www.copper.org">www.copper.org</a></td>
<td>(212) 251-7200</td>
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<td>CEA</td>
<td>Canadian Electricity Association</td>
<td>(613) 230-9263</td>
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<td>CEA</td>
<td>Consumer Electronics Association</td>
<td>(866) 858-1555</td>
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<td><a href="http://www.ce.org">www.ce.org</a></td>
<td>(703) 907-7600</td>
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<td>CFFA</td>
<td>Chemical Fabrics &amp; Film Association, Inc.</td>
<td>(216) 241-7333</td>
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<td><a href="http://www.chemicalfabricsandfilm.com">www.chemicalfabricsandfilm.com</a></td>
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<td>CFSEI</td>
<td>Cold-Formed Steel Engineers Institute</td>
<td>(866) 465-4732</td>
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<td><a href="http://www.cfsei.org">www.cfsei.org</a></td>
<td>(202) 263-4488</td>
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<td>CGA</td>
<td>Compressed Gas Association</td>
<td>(703) 788-2700</td>
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<td><a href="http://www.egnanet.com">www.egnanet.com</a></td>
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<td>CIMA</td>
<td>Cellulose Insulation Manufacturers Association</td>
<td>(888) 881-2462</td>
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<td><a href="http://www.cellulose.org">www.cellulose.org</a></td>
<td>(937) 222-2462</td>
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<td>CISCA</td>
<td>Ceilings &amp; Interior Systems Construction Association</td>
<td>(630) 584-1919</td>
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<td><a href="http://www.cisca.org">www.cisca.org</a></td>
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<td>CISPI</td>
<td>Cast Iron Soil Pipe Institute</td>
<td>(404) 622-0073</td>
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<td><a href="http://www.cispi.org">www.cispi.org</a></td>
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<td>CLFMI</td>
<td>Chain Link Fence Manufacturers Institute</td>
<td>(301) 596-2583</td>
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<td><a href="http://www.chainlinkinfo.org">www.chainlinkinfo.org</a></td>
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<td>CPA</td>
<td>Composite Panel Association</td>
<td>(703) 724-1128</td>
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<td><a href="http://www.pbmfd.com">www.pbmfd.com</a></td>
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<td>CRI</td>
<td>Carpet and Rug Institute (The)</td>
<td>(706) 278-3176</td>
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<td><a href="http://www.carpet-rug.org">www.carpet-rug.org</a></td>
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<td>CRRC</td>
<td>Cool Roof Rating Council</td>
<td>(866) 465-2523</td>
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<td><a href="http://www.coolroofs.org">www.coolroofs.org</a></td>
<td>(510) 485-7175</td>
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<td>CRSI</td>
<td>Concrete Reinforcing Steel Institute</td>
<td>(800) 328-6306</td>
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<td><a href="http://www.crsi.org">www.crsi.org</a></td>
<td>(847) 517-1200</td>
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<td>CSA</td>
<td>Canadian Standards Association</td>
<td>(800) 463-6727 (416) 747-4000</td>
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<td>CSA</td>
<td>CSA International (Formerly: IAS - International Approval Services)</td>
<td>(866) 797-4272 (416) 747-4000</td>
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<td>CSI</td>
<td>Construction Specifications Institute (The)</td>
<td>(800) 689-2900 (703) 684-0300</td>
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<td>CSSB</td>
<td>Cedar Shake &amp; Shingle Bureau</td>
<td>(604) 820-7700</td>
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<td>CTI</td>
<td>Cooling Technology Institute (Formerly: Cooling Tower Institute)</td>
<td>(281) 583-4087</td>
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<td>CWC</td>
<td>Composite Wood Council (See CPA)</td>
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<td>DASMA</td>
<td>Door and Access Systems Manufacturers Association</td>
<td>(216) 241-7333</td>
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<td>DHI</td>
<td>Door and Hardware Institute</td>
<td>(703) 222-2010</td>
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<td>ECA</td>
<td>Electronic Components Association</td>
<td>(703) 907-8024</td>
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<td>ECAMA</td>
<td>Electronic Components Assemblies &amp; Materials Association (See ECA)</td>
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<td>EIA</td>
<td>Electronic Industries Alliance (See TIA)</td>
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<td>EIMA</td>
<td>EIFS Industry Members Association</td>
<td>(800) 294-3462 (703) 538-1616</td>
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<td>EJMA</td>
<td>Expansion Joint Manufacturers Association, Inc.</td>
<td>(914) 332-0040</td>
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<td>ESD</td>
<td>ESD Association (Electrostatic Discharge Association)</td>
<td>(315) 339-6937</td>
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<td>ESTA</td>
<td>Entertainment Services and Technology Association (See PLASA)</td>
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<tr>
<td>EVO</td>
<td>Efficiency Valuation Organization</td>
<td>(415) 367-3643 44 20 88 167 857</td>
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<td>FIBA</td>
<td>Fédération Internationale de Basketball (The International Basketball Federation)</td>
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<td>FM Approvals</td>
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<td>FRSA</td>
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<td>Gypsum Association</td>
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<td>GANA</td>
<td>Glass Association of North America</td>
<td><a href="http://www.glasswebsite.com">www.glasswebsite.com</a></td>
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<td>GS</td>
<td>Green Seal</td>
<td><a href="http://www.greenseal.org">www.greenseal.org</a></td>
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<td>HI</td>
<td>Hydraulic Institute</td>
<td><a href="http://www.pumps.org">www.pumps.org</a></td>
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<td>HI/GAMA</td>
<td>Hydronics Institute/Gas Appliance Manufacturers Association (See AHRI)</td>
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<td>HMMA</td>
<td>Hollow Metal Manufacturers Association (See NAAMM)</td>
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<td>HPVA</td>
<td>Hardwood Plywood &amp; Veneer Association</td>
<td><a href="http://www.hpva.org">www.hpva.org</a></td>
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<tr>
<td>HPW</td>
<td>H. P. White Laboratory, Inc.</td>
<td><a href="http://www.hpwhite.com">www.hpwhite.com</a></td>
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<tr>
<td>IAPSC</td>
<td>International Association of Professional Security Consultants</td>
<td><a href="http://www.iapsc.org">www.iapsc.org</a></td>
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<td>IAS</td>
<td>International Approval Services (See CSA)</td>
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<td>ICBO</td>
<td>International Conference of Building Officials (See ICC)</td>
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<tr>
<td>ICC</td>
<td>International Code Council</td>
<td><a href="http://www.iccsafe.org">www.iccsafe.org</a></td>
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</tbody>
</table>

REFERENCES
ICEA Insulated Cable Engineers Association, Inc. www.icea.net (770) 830-0369

ICPA International Cast Polymer Alliance www.icpa-hq.org (703) 525-0511

ICRI International Concrete Repair Institute, Inc. www.icri.org (847) 827-0830

IEC International Electrotechnical Commission www.iec.ch

IEEE Institute of Electrical and Electronics Engineers, Inc. (The) www.ieee.org (212) 419-7900

IES Illuminating Engineering Society (Formerly: Illuminating Engineering Society of North America) www.ies.org (212) 248-5000

IESNA Illuminating Engineering Society of North America (See IES)

IEST Institute of Environmental Sciences and Technology www.iest.org (847) 981-0100

IGMA Insulating Glass Manufacturers Alliance www.igmaonline.org (613) 233-1510

IGSHPA International Ground Source Heat Pump Association www.igshpa.okstate.edu (405) 744-5175

ILI Indiana Limestone Institute of America, Inc. www.iliai.com (812) 275-4426

Intertek Intertek Group (Formerly: ETL SEMCO; Intertek Testing Service NA) www.intertek.com (800) 967-5352

ISA International Society of Automation (The) (Formerly: Instrumentation, Systems, and Automation Society) www.isa.org (919) 549-8411

ISAS Instrumentation, Systems, and Automation Society (The) (See ISA)

ISFA International Surface Fabricators Association (Formerly: International Solid Surface Fabricators Association) www.isfanow.org (877) 464-7732

ISO International Organization for Standardization www.iso.org 41 22 749 01 11

ISSFA International Solid Surface Fabricators Association (See ISFA)
REFERENCES

ITU International Telecommunication Union
www.itu.int/home

KCMA Kitchen Cabinet Manufacturers Association
www.kcma.org

LMA Laminating Materials Association
(See CPA)

LPI Lightning Protection Institute
www.lightning.org

MBMA Metal Building Manufacturers Association
www.mbma.com

MCA Metal Construction Association
www.metalconstruction.org

MFMA Maple Flooring Manufacturers Association, Inc.
www.maplefloor.org

MFMA Metal Framing Manufacturers Association, Inc.
www.metalframingmfg.org

MHIA Material Handling Industry of America
www.mhia.org

MIA Marble Institute of America
www.marble-institute.com

MMPA Moulding & Millwork Producers Association
(Formerly: Wood Moulding & Millwork Producers Association)
www.wmmpa.com

MPI Master Painters Institute
www.paintinfo.com

MSS Manufacturers Standardization Society of The Valve and Fittings Industry Inc.
www.mss-hq.org

NAAMM National Association of Architectural Metal Manufacturers
www.naamm.org

NACE NACE International
(National Association of Corrosion Engineers International)
www.nace.org

NADCA National Air Duct Cleaners Association
www.nadca.com

NAIMA North American Insulation Manufacturers Association
www.naima.org

NBGQA National Building Granite Quarries Association, Inc.
www.nbgba.com
<table>
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<tr>
<th>Acronym</th>
<th>Name</th>
<th>Website</th>
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<tr>
<td>NCAA</td>
<td>National Collegiate Athletic Association (The)</td>
<td><a href="http://www.ncaa.org">www.ncaa.org</a></td>
<td>(317) 917-6222</td>
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<tr>
<td>NCMA</td>
<td>National Concrete Masonry Association</td>
<td><a href="http://www.ncma.org">www.ncma.org</a></td>
<td>(703) 713-1900</td>
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<tr>
<td>NEBB</td>
<td>National Environmental Balancing Bureau</td>
<td><a href="http://www.nebb.org">www.nebb.org</a></td>
<td>(301) 977-3698</td>
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<td>NECA</td>
<td>National Electrical Contractors Association</td>
<td><a href="http://www.necanet.org">www.necanet.org</a></td>
<td>(301) 657-3110</td>
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<tr>
<td>NeLMA</td>
<td>Northeastern Lumber Manufacturers Association</td>
<td><a href="http://www.nelma.org">www.nelma.org</a></td>
<td>(207) 829-6901</td>
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<tr>
<td>NEMA</td>
<td>National Electrical Manufacturers Association</td>
<td><a href="http://www.nema.org">www.nema.org</a></td>
<td>(703) 841-3200</td>
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<tr>
<td>NETA</td>
<td>InterNational Electrical Testing Association</td>
<td><a href="http://www.netaworld.org">www.netaworld.org</a></td>
<td>(888) 300-6382, (269) 488-6382</td>
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<tr>
<td>NFHS</td>
<td>National Federation of State High School Associations</td>
<td><a href="http://www.nfhs.org">www.nfhs.org</a></td>
<td>(317) 972-6900</td>
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<tr>
<td>NFPA</td>
<td>NFPA (National Fire Protection Association)</td>
<td><a href="http://www.nfpa.org">www.nfpa.org</a></td>
<td>(800) 344-3555, (617) 770-3000</td>
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<td>NFMIA</td>
<td>National Oak Flooring Manufacturers Association</td>
<td>(See NWFA)</td>
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<tr>
<td>NFRC</td>
<td>National Fenestration Rating Council</td>
<td><a href="http://www.nfrc.org">www.nfrc.org</a></td>
<td>(301) 589-1776</td>
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<tr>
<td>NHLA</td>
<td>National Hardwood Lumber Association</td>
<td><a href="http://www.nhla.com">www.nhla.com</a></td>
<td>(800) 933-0318, (901) 377-1818</td>
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<td>NLGA</td>
<td>National Lumber Grades Authority</td>
<td><a href="http://www.nlga.org">www.nlga.org</a></td>
<td>(604) 524-2393</td>
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<td>NOFMA</td>
<td>National Oak Flooring Manufacturers Association (See NWFA)</td>
<td>(See NWFA)</td>
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<td>NOMMA</td>
<td>National Ornamental &amp; Miscellaneous Metals Association</td>
<td><a href="http://www.nomma.org">www.nomma.org</a></td>
<td>(888) 516-8585</td>
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<td>NRCA</td>
<td>National Roofing Contractors Association</td>
<td><a href="http://www.nrca.net">www.nrca.net</a></td>
<td>(800) 323-9545, (847) 299-9070</td>
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<tr>
<td>NRMCA</td>
<td>National Ready Mixed Concrete Association</td>
<td><a href="http://www.nrmca.org">www.nrmca.org</a></td>
<td>(888) 846-7622, (301) 587-1400</td>
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<td>NSF</td>
<td>NSF International (National Sanitation Foundation International)</td>
<td><a href="http://www.nsf.org">www.nsf.org</a></td>
<td>(800) 673-6275, (734) 769-8010</td>
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<td>Organization</td>
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<td>NSPE</td>
<td>National Society of Professional Engineers</td>
<td>(703) 684-2800</td>
<td><a href="http://www.nspe.org">www.nspe.org</a></td>
</tr>
<tr>
<td>NSSGA</td>
<td>National Stone, Sand &amp; Gravel Association</td>
<td>(800) 342-1415</td>
<td><a href="http://www.nssga.org">www.nssga.org</a></td>
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<td>NTMA</td>
<td>National Terrazzo &amp; Mosaic Association, Inc. (The)</td>
<td>(800) 323-9736</td>
<td><a href="http://www.ntma.com">www.ntma.com</a></td>
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<tr>
<td>NWFA</td>
<td>National Wood Flooring Association</td>
<td>(800) 422-4556</td>
<td><a href="http://www.nwfa.org">www.nwfa.org</a></td>
</tr>
<tr>
<td>PCI</td>
<td>Precast/Prestressed Concrete Institute</td>
<td>(312) 786-0300</td>
<td><a href="http://www.pci.org">www.pci.org</a></td>
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<td>PDI</td>
<td>Plumbing &amp; Drainage Institute</td>
<td>(800) 589-8956</td>
<td><a href="http://www.pdionline.org">www.pdionline.org</a></td>
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<tr>
<td>PLASA</td>
<td>PLASA (Formerly: ESTA - Entertainment Services and Technology Association)</td>
<td>(212) 244-1505</td>
<td><a href="http://www.plasa.org">www.plasa.org</a></td>
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<td>RCSC</td>
<td>Research Council on Structural Connections</td>
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<td><a href="http://www.boltcouncil.org">www.boltcouncil.org</a></td>
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<td>RFCI</td>
<td>Resilient Floor Covering Institute</td>
<td>(706) 882-3833</td>
<td><a href="http://www.rfci.com">www.rfci.com</a></td>
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<tr>
<td>RIS</td>
<td>Redwood Inspection Service</td>
<td>(925) 935-1499</td>
<td><a href="http://www.redwoodinspection.com">www.redwoodinspection.com</a></td>
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<tr>
<td>SAE</td>
<td>SAE International (Society of Automotive Engineers)</td>
<td>(877) 606-7323</td>
<td><a href="http://www.sae.org">www.sae.org</a></td>
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<td>SBCCI</td>
<td>Southern Building Code Congress International, Inc. (See ICC)</td>
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<td>SCTE</td>
<td>Society of Cable Telecommunications Engineers</td>
<td>(800) 542-5040</td>
<td><a href="http://www.scte.org">www.scte.org</a></td>
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<tr>
<td>SDI</td>
<td>Steel Deck Institute</td>
<td>(847) 458-4647</td>
<td><a href="http://www.sdi.org">www.sdi.org</a></td>
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<td>SDI</td>
<td>Steel Door Institute</td>
<td>(440) 899-0010</td>
<td><a href="http://www.steeldoor.org">www.steeldoor.org</a></td>
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<td>SEFA</td>
<td>Scientific Equipment and Furniture Association</td>
<td>(877) 294-5424</td>
<td><a href="http://www.sefalabs.com">www.sefalabs.com</a></td>
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<td>SEI/ASCE</td>
<td>Structural Engineering Institute/American Society of Civil Engineers (See ASCE)</td>
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<td>SIA</td>
<td>Security Industry Association</td>
<td>(866) 817-8888</td>
<td><a href="http://www.siaonline.org">www.siaonline.org</a></td>
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<td>SJI</td>
<td>Steel Joist Institute</td>
<td>(843) 293-1995</td>
<td><a href="http://www.steeljoist.org">www.steeljoist.org</a></td>
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<td>SMA</td>
<td>Screen Manufacturers Association</td>
<td>(773) 636-0672</td>
<td><a href="http://www.smainfo.org">www.smainfo.org</a></td>
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<td>SMACNA</td>
<td>Sheet Metal and Air Conditioning Contractors’ National Association</td>
<td>(703) 803-2980</td>
<td><a href="http://www.smacna.org">www.smacna.org</a></td>
</tr>
<tr>
<td>SMPTE</td>
<td>Society of Motion Picture and Television Engineers</td>
<td>(914) 761-1100</td>
<td><a href="http://www.smpte.org">www.smpte.org</a></td>
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<td>SPFA</td>
<td>Spray Polyurethane Foam Alliance</td>
<td>(800) 523-6154</td>
<td><a href="http://www.sprayfoam.org">www.sprayfoam.org</a></td>
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<td>SPIB</td>
<td>Southern Pine Inspection Bureau</td>
<td>(850) 434-2611</td>
<td><a href="http://www.spib.org">www.spib.org</a></td>
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<td>SPRI</td>
<td>Single Ply Roofing Industry</td>
<td>(781) 647-7026</td>
<td><a href="http://www.spri.org">www.spri.org</a></td>
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<tr>
<td>SSINA</td>
<td>Specialty Steel Industry of North America</td>
<td>(800) 982-0355</td>
<td><a href="http://www.ssina.com">www.ssina.com</a></td>
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<td>SSPC</td>
<td>SSPC: The Society for Protective Coatings</td>
<td>(877) 281-7772</td>
<td><a href="http://www.sspx.org">www.sspx.org</a></td>
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<td>STI</td>
<td>Steel Tank Institute</td>
<td>(847) 438-8265</td>
<td><a href="http://www.steeltank.com">www.steeltank.com</a></td>
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<td>SWI</td>
<td>Steel Window Institute</td>
<td>(216) 241-7333</td>
<td><a href="http://www.steelwindows.com">www.steelwindows.com</a></td>
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<td>SWPA</td>
<td>Submersible Wastewater Pump Association</td>
<td>(847) 681-1868</td>
<td><a href="http://www.swpa.org">www.swpa.org</a></td>
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<td>TCA</td>
<td>Tilt-Up Concrete Association</td>
<td>(319) 895-6911</td>
<td><a href="http://www.tilt-up.org">www.tilt-up.org</a></td>
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<td>TCNA</td>
<td>Tile Council of North America, Inc. (Formerly: Tile Council of America)</td>
<td>(864) 646-8453</td>
<td><a href="http://www.tileusa.com">www.tileusa.com</a></td>
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<td>TEMA</td>
<td>Tubular Exchanger Manufacturers Association, Inc.</td>
<td>(914) 332-0040</td>
<td><a href="http://www.teama.org">www.teama.org</a></td>
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<td>TIA</td>
<td>Telecommunications Industry Association (Formerly: TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance)</td>
<td>(703) 907-7700</td>
<td><a href="http://www.tiaonline.org">www.tiaonline.org</a></td>
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<td>Acronym</td>
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<tr>
<td>TIA/EIA</td>
<td>Telecommunications Industry Association/Electronic Industries Alliance (See TIA)</td>
<td>(303) 939-9700</td>
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<td>TMS</td>
<td>The Masonry Society</td>
<td><a href="http://www.masonrysociety.org">www.masonrysociety.org</a></td>
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<td>TPI</td>
<td>Truss Plate Institute</td>
<td><a href="http://www.tpiinst.org">www.tpiinst.org</a></td>
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<td>TPI</td>
<td>Turfgrass Producers International</td>
<td><a href="http://www.turfgrasssod.org">www.turfgrasssod.org</a> (800) 405-8873 (847) 649-5555</td>
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<tr>
<td>TRI</td>
<td>Tile Roofing Institute</td>
<td><a href="http://www.tileroofing.org">www.tileroofing.org</a> (312) 670-4177</td>
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<td>UBC</td>
<td>Uniform Building Code (See ICC)</td>
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<td>UL</td>
<td>Underwriters Laboratories Inc.</td>
<td><a href="http://www.ul.com">www.ul.com</a> (877) 854-3577</td>
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<td>UNI</td>
<td>Uni-Bell PVC Pipe Association</td>
<td><a href="http://www.uni-bell.org">www.uni-bell.org</a> (972) 243-3902</td>
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<td>USAV</td>
<td>USA Volleyball</td>
<td><a href="http://www.usavolleyball.org">www.usavolleyball.org</a> (888) 786-5539 (719) 228-6800</td>
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<td>USGBC</td>
<td>U.S. Green Building Council</td>
<td><a href="http://www.usgbc.org">www.usgbc.org</a> (800) 795-1747</td>
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<tr>
<td>USITT</td>
<td>United States Institute for Theatre Technology, Inc.</td>
<td><a href="http://www.usitt.org">www.usitt.org</a> (800) 938-7488 (315) 463-6463</td>
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<td>WASTEC</td>
<td>Waste Equipment Technology Association</td>
<td><a href="http://www.wastec.org">www.wastec.org</a> (800) 424-2869 (202) 244-4700</td>
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<tr>
<td>WCLIB</td>
<td>West Coast Lumber Inspection Bureau</td>
<td><a href="http://www.wclib.org">www.wclib.org</a> (800) 283-1486 (503) 639-0651</td>
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<tr>
<td>WCMA</td>
<td>Window Covering Manufacturers Association</td>
<td><a href="http://www.wcmanet.org">www.wcmanet.org</a> (212) 297-2122</td>
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<td>WDMA</td>
<td>Window &amp; Door Manufacturers Association</td>
<td><a href="http://www.wdma.com">www.wdma.com</a> (800) 223-2301 (312) 321-6802</td>
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<tr>
<td>WI</td>
<td>Woodwork Institute (Formerly: WIC - Woodwork Institute of California)</td>
<td><a href="http://www.wicnet.org">www.wicnet.org</a> (916) 372-9943</td>
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<td>WMMPA</td>
<td>Wood Moulding &amp; Millwork Producers Association (See MMPA)</td>
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<td>WSRCA</td>
<td>Western States Roofing Contractors Association</td>
<td><a href="http://www.wsrca.com">www.wsrca.com</a> (800) 725-0333 (650) 938-5441</td>
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</tbody>
</table>
B. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

DIN Deutsches Institut für Normung e.V. (49) 30 2601-0
www.din.de

IAPMO International Association of Plumbing and Mechanical Officials (909) 472-4100
www.iapmo.org

ICC International Code Council (888) 422-7233
www.iccsafe.org

ICC-ES ICC Evaluation Service, LLC (800) 423-6587
www.icc-es.org (562) 699-0543

C. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

COE Army Corps of Engineers (202) 761-0011
www.usace.army.mil

CPSC Consumer Product Safety Commission (800) 638-2772 (301) 504-7923
www.cpsc.gov

DOC Department of Commerce (301) 975-4040
National Institute of Standards and Technology www.nist.gov

DOD Department of Defense (215) 697-2664
http://dodssp.daps.dla.mil

DOE Department of Energy (202) 586-9220
www.energy.gov

EPA Environmental Protection Agency (202) 272-0167
www.epa.gov

FAA Federal Aviation Administration (866) 835-5322
www.faa.gov

www.gpo.gov

GSA General Services Administration (800) 488-3111 (202) 619-8925
www.gsa.gov

HUD Department of Housing and Urban Development (202) 708-1112
www.hud.gov
**REFERENCES**

D. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

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<tr>
<th>Abbreviation</th>
<th>Name</th>
<th>Phone</th>
<th>Web Site</th>
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<tr>
<td>DOD</td>
<td>Department of Defense</td>
<td>(215) 697-2664</td>
<td><a href="http://dodssp.daps.dla.mil">http://dodssp.daps.dla.mil</a></td>
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<tr>
<td>DSCC</td>
<td>Defense Supply Center Columbus</td>
<td>(See FS)</td>
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<td>FED-STD</td>
<td>Federal Standard</td>
<td>(See FS)</td>
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<td>FS</td>
<td>Federal Specification</td>
<td>(215) 697-2664</td>
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Available from Department of Defense Single Stock Point
http://dodssp.daps.dla.mil

Available from Defense Standardization Program
www.dsp.dla.mil

Available from General Services Administration
www.gsa.gov

Available from National Institute of Building Sciences/Whole Building
Design Guide
www.wbdg.org/ccb

MILSPEC Military Specification and Standards
(See DOD)

USAB United States Access Board
www.access-board.gov

USATBCB U.S. Architectural & Transportation Barriers Compliance Board
(See USAB)

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 42 00
SECTION 01 60 00

PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

B. Related Requirements:

1. Section 01 21 00 "Allowances" for products selected under an allowance, if applicable.
2. Section 01 23 00 "Alternates" for products selected under an alternate, if applicable.
3. Section 01 25 00 "Substitution Procedures" for requests for substitutions.
4. Section 01 42 00 "References" for applicable industry standards for products specified.
5. Section 01 77 00 “Closeout Procedures” for submittal of project warranties.

1.3 DEFINITIONS

A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Basis-of-Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.
1.4 ACTION SUBMITTALS

A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Requests for consideration of comparable products will only be entertained during bidding.
2. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
3. Architect/Engineer's Action: If necessary, Architect/Engineer will request additional information or documentation for evaluation of a comparable product request. Architect/Engineer will notify Contractor of approval or rejection of proposed comparable product.
   a. Form of Approval: Written Addendum.

B. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 01 33 00 "Submittal Procedures." Show compliance with requirements.

1.5 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options. The complete compatibility between the various choices available to the Contractor is not assured by the various requirements of the Contract Documents, but must be provided by the Contractor.

B. Source Limitations: To the fullest extent possible, provide products of the same kind, from a single source.

C. Nameplates: Except for required labels and operating data, do not attach or imprint manufacturers or producer's nameplates or trademarks on exposed surfaces of products which will be exposed to view in occupied spaces or on the exterior.

D. Labels: Locate required product labels and stamps on a concealed surface or, where required for observation after installation, on an accessible surface that is not conspicuous.

E. Equipment Nameplates: Provide a permanent nameplate on each item of service-connected or power-operated equipment. Locate on an easily accessible surface which is inconspicuous in occupied spaces. The nameplate shall contain the following information and other essential operating data.

1. Name of product and manufacturer.
2. Model and serial number.
3. Capacity.
4. Speed.
5. Ratings.
6. Power characteristics (if applicable).
7. UL label or compliance (if applicable).

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
B. Delivery and Handling:
   1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
   2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
   3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, unpacking, protecting, and installing.
   4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.

C. Storage:
   1. Store products to allow for inspection and measurement of quantity or counting of units.
   2. Store materials in a manner that will not endanger Project structure.
   3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
   4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
   5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
   6. Protect stored products from damage and liquids from freezing.

1.7 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents. Such disclaimers and limitations do not relieve warranty requirements on Work that incorporates product nor do they relieve suppliers, manufacturers and subcontractors required to countersign special warranties with the Contractor.

   1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to University.
   2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for University.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.

   1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
   2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
   3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time and Form: Comply with requirements in Section 01 77 00 "Closeout Procedures."

D. Warranty Requirements:
1. 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.

2. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.

3. Replacement Cost: Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective Work regardless of whether the University has benefited from use of the Work through a portion of its anticipated useful service life.

4. University's Recourse:
   a. Written warranties made to the University are in addition to implied warranties, and shall not limit the duties, obligations, rights and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the University can enforce such other duties, obligations, rights, or remedies.
   b. Rejection of Warranties: The University reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Contract Documents.
   c. The University reserves the right to refuse to accept Work for the Project where a special warranty, certification, or similar commitment is required on such Work or part of the Work, until evidence is presented that entities required to countersign such commitments are willing to do so.

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged, are asbestos free, and, unless otherwise indicated, are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. University reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Architect/Engineer will make selection.
6. Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product and provide only products previously approved during bid phase by written Addendum. The determination of equivalence is at the sole discretion of the Architect/Engineer who has no obligation to prove non-equivalence.
7. Mechanical and electrical equipment design and their space requirements are based on the first named item of the Section in which specified or that scheduled on the Drawings. If other than the first named or scheduled item listed for use is selected, modification to other elements of Work may be required. Show all such modification on shop drawings and submittals as appropriate. The cost of such modifications is solely the responsibility of the Contractor.
PRODUCT REQUIREMENTS 01 60 00 - 5

8. Where manufacturers are listed as acceptable for specific proprietary products but precise identification by model, series, or trade name is not specified, submit detailed product information for such products for Architect/Engineer's acceptance prior to ordering. Include specific requirements for modifications to other construction, including but not limited to, power and utility requirements, characteristics, capacities, size and locations. The cost of such modifications is solely the responsibility of the Contractor.

B. Product Selection Procedures:

1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

3. Products:
   a. Restricted List: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

4. Manufacturers:
   a. Restricted List: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

5. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. If proposing a comparable product by another manufacturer, whether named or not, provide a custom product if manufacturer's standard product does not include salient features of the Basis-of-Design product indicated. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

6. Contractor’s Option: Where materials, products, systems or methods are specified to be selected from a list of options, subject to compliance with requirements, the choice of which material, method, product or system will be solely at the Contractor's discretions. There will be no change in Contract Sum or Time because of such choice.

C. Visual Matching Specification: Where Specifications require "match Architect/Engineer's sample", provide a product that complies with requirements and matches Architect/Engineer's sample. Architect/Engineer's decision will be final on whether a proposed product matches.

1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 01 25 00 "Substitution Procedures" for proposal of product.

D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect/Engineer from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect/Engineer will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.
2.2 COMPARABLE PRODUCTS

A. Conditions for Consideration: Prior to bid, Architect/Engineer will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect/Engineer will reject request:

1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 60 00
SECTION 01 73 00

EXECUTION

PART 1 - GENERAL

1.1   RELATED DOCUMENTS

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

1.2   SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:

2. Field engineering and surveying.
3. Installation of the Work.
4. Cutting and patching.
5. Coordination of University-installed products.
6. Progress cleaning.
7. Starting and adjusting.
8. Protection of installed construction.

B. Related Requirements:

1. Section 01 10 00 "Summary" for limits on use of Project site and procedures related to utility interruptions.

1.3   DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of other work.

B. Patching: Fitting and repair work required to restore construction to original conditions after installation of other work.

1.4   INFORMATIONAL SUBMITTALS

A. Qualification Data: For land surveyor or professional engineer.

B. Certificates: Submit certificate signed by land surveyor or professional engineer certifying that location and elevation of improvements comply with requirements.

C. Cutting and Patching Plan and Request: Submit plan and request describing procedures at least 21 calendar days prior to the time cutting and patching will be performed.

1. Submit request whenever cutting and patching operation affect:
a. Work of the University or any separate contractor.
b. Structural value or integrity of any element of the Project.
c. Integrity or effectiveness of weather-exposed or moisture-resistant elements or systems.
d. Efficiency, operational life, maintenance or safety of operational elements.
e. Visual qualities of sight-exposed elements.
f. Cutting new openings in existing structural concrete walls, floors and suspended slabs.
g. Cutting new openings in existing roofs and roofing materials.
h. Cutting exterior walls.
i. Cutting into shafts.

2. Include the following information:

a. Extent: Describe reason for and extent of each occurrence of cutting and patching, including explanation of why cutting and patching operation cannot be reasonable avoided.
b. Changes to In-Place Construction: Describe cutting and patching methods and anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
c. Products: List products to be used for patching and firms or entities that will perform patching work.
d. Trades: Indicate trades and subcontractors who will perform the work.
e. Dates: Indicate when cutting and patching will be performed.
f. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.

1) Include description of provisions for temporary services and systems during interruption of permanent services and systems.
2) Comply with requirements of Section 01 10 00 “Summary” related to existing utility and system interruptions.

g. Structural Elements: Where cutting and patching structural elements requires the addition of reinforcement, submit details and calculations signed and sealed by an Engineer registered in the State of Colorado. Indicate how new reinforcing will be integrated with original structure.

3. Limitations: Approval of cutting and patching request does not waive right of Architect/Engineer or University to later require complete removal and replacement of work found to be unsatisfactorily cut and patched.

D. Certified Surveys: Submit two copies signed by land surveyor or professional engineer.

E. Final Property Survey: Submit one electronic and two paper copies showing the Work performed and record survey data.

1. Include certified statement that lines and levels of the work comply with the requirements of the Contract Documents and listing authorized or accepted deviations, cross-referenced to Change Order number, where applicable.

1.5 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.
B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.

1. Structural Elements: When cutting and patching structural elements, notify Architect/Engineer of locations and details of cutting and await directions from Architect/Engineer before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.

2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include but are not limited to the following:
   a. Primary operational systems and equipment.
   b. Fire separation assemblies.
   c. Air or smoke barriers.
   d. Fire-suppression systems.
   e. Mechanical systems piping and ducts.
   f. Control systems.
   g. Communication systems.
   h. Fire-detection and -alarm systems.
   i. Conveying systems.
   j. Electrical wiring systems.
   k. Operating systems of special construction.

3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:
   a. Water, moisture, or vapor barriers.
   b. Membranes and flashings.
   c. Exterior curtain-wall construction.
   d. Sprayed fire-resistive material.
   e. Equipment supports.
   f. Piping, ductwork, vessels, and equipment.
   g. Noise- and vibration-control elements and systems.

4. Visual Elements: Do not cut and patch construction exposed to the exterior or exposed in occupied spaces in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect/Engineer's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

5. Hazardous Materials: Do not proceed with cutting and patching operations until University has examined existing construction for the presence of asbestos and/or lead-based coatings. Comply with requirements in Section 01 35 00 “Special Procedures.”

C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.
PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.

1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with requirements in Division 01 Section “Sustainable Design Requirements.”

B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect/Engineer for the visual and functional performance of in-place materials.

C. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work. Notify University Project Manager and Architect/Engineer and obtain approval prior to disturbing, moving or penetrating soil.

1. Arrange for locating buried utilities including water and sewer lines within construction limits. Obtain location information and stake all known utilities prior to commencing construction activities.

   a. Contact Utility Notification Center of Colorado (UNCC), 1-800-922-1987, and comply with UNCC guidelines.

2. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services, and other utilities.

3. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present, for compliance with requirements for installation tolerances and other conditions affecting performance.

1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
4. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to local utility or University, as appropriate, that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect/Engineer according to requirements in Section 01 31 00 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect/Engineer promptly.

B. General: Engage a land surveyor or professional engineer to lay out the Work using accepted surveying practices.

1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
2. Establish limits on use of Project site.
3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
4. Inform installers of lines and levels to which they must comply.
5. Check the location, level and plumb, of every major element as the Work progresses.
6. Notify Architect/Engineer when deviations from required lines and levels exceed allowable tolerances. Record deviation which are accepted (i.e., not corrected) on record drawings in accordance with the requirements of Section 01 78 39 “Project Record Documents.”
7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect/Engineer.

3.4 FIELD ENGINEERING

A. Identification: University will identify existing benchmarks, control points, and property corners.

B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect/Engineer. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect/Engineer before proceeding.

2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.

2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.

3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.

E. Final Property Survey: Engage a land surveyor or professional engineer to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor or professional engineer, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.

1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.

2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."
3.5 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
   1. Make vertical work plumb and make horizontal work level.
   2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
   3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated to the extent they are more explicit or stringent than requirements of the Contract Documents.

C. Install products at the time and under conditions, including weather that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Isolate each part of complete installation from incompatible material as needed to prevent deterioration.

E. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

F. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.

G. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

H. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

I. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned, true and level as applicable, with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
   1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect/Engineer.
   2. Allow for building movement, including thermal expansion and contraction.
   3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

J. Attachment to Concrete:
   1. No drilled inserts or powder-actuated fasteners are permitted in pre-stressed concrete except as specifically authorized by Contractor and carried out under the direct supervision of its Superintendent.
   2. Only those devices with a maximum controlled penetration of 3/4 inch or less will be permitted. Make holes through slabs by means of sleeves placed no closer than 2 inch from tensioning cables. Core drilling will not be permitted unless unavoidable and as specified for cutting and patching in this Section.
K. Joints: Unless indicated otherwise, make joints of uniform width. Where joint locations in exposed work are required but not indicated, arrange joints for the best visual effect. Confirm arrangement with Architect/Engineer before proceeding. Fit exposed connections together to form hairline joints.

L. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.6 CUTTING AND PATCHING

A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Responsibility: Provide cutting and patching work, including attendant excavation and backfill required to complete the Work or to:

1. Make components fit together properly.
2. Uncover portions of the Work to provide for installation of ill-timed work.
3. Remove and replace defective work or work not conforming to requirements of Contract Documents.
4. Remove samples of installed work as specified for testing.
5. Provide routine penetrations of non-structural surfaces for installation of piping and electrical conduit.

C. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.

D. Temporary Support: Provide temporary support of work to be cut.

E. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

F. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in Section 01 10 00 "Summary."

G. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas, coordinate cutting and patching according to requirements in Section 01 10 00 "Summary."

H. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.

4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations. Employ methods which will prevent settlement or damage to other work.

5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.

6. Proceed with patching after construction operations requiring cutting are complete.

I. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements, including tolerance, specified in other Sections, where applicable.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.

2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
   a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
   b. Restore damaged pipe covering to its original condition.

3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
   a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.

5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

J. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 UNIVERSITY-INSTALLED PRODUCTS

A. Site Access: Provide access to Project site for University's construction personnel.

B. Coordination: Coordinate construction and operations of the Work with work performed by University's construction personnel.

1. Construction Schedule: Inform University of Contractor's preferred construction schedule for University's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify University if changes to schedule are required due to differences in actual construction progress.
2. **Preinstallation Conferences:** Include University's construction personnel at preinstallation conferences covering portions of the Work that are to receive University's work. Attend preinstallation conferences conducted by University's construction personnel if portions of the Work depend on University's construction.

### 3.8 PROGRESS CLEANING

A. **General:** Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.

2. Do not hold waste materials more than seven calendar days during normal weather or three calendar days if the temperature is expected to rise above 80 deg F.
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
   a. Use containers intended for holding waste materials of type to be stored.

B. **Collection Point:** Review location with University and obtain approval.

C. **Site:** Maintain Project site free of waste materials and debris.

D. **Wind Blown Debris:** Prevent spread of trash, debris, cartons, packing material, or other waste on or off Project site by wind.

E. **Dust:** Sprinkle dusty debris with water.

F. **Packing Materials:** Immediately after uncrating or unpacking materials or equipment, remove all crating, lumber, excelsior, wrapping or other like combustible materials from building to central collection facility.

G. **Work Areas:** Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

H. **Installed Work:** Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

I. **Concealed Spaces:** Remove debris from concealed spaces before enclosing the space.

J. **Exposed Surfaces in Finished Areas:** Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

K. **Waste Disposal:** Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 01 74 19 "Construction Waste Management and Disposal."
L. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

M. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

N. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

O. Snow and Ice: Remove snow and ice from sidewalks adjacent to site and from access ways to building and construction site.

P. Streets: At frequency required by University and/or governing authority, clean adjacent and nearby streets of dirt resulting from construction operations.

3.9 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Manufacturer's Field Service: Comply with qualification requirements in Section 01 40 00 "Quality Requirements."

3.10 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Comply with manufacturer's written instructions for temperature and relative humidity.

C. Limiting Exposures: Supervise construction activities to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period. Where applicable, such exposures include, but are not limited to, the following:

1. Excessive static or dynamic loading.
2. Excessive internal or external pressures.
3. Excessively high or low temperatures.
4. Thermal shock.
5. Excessively high or low humidity.
6. Air contamination or pollution.
7. Water or ice.
8. Solvents.
10. Light.
11. Radiation.
12. Puncture.
13. Abrasion.
14. Heavy traffic.
15. Soiling, staining and corrosion.
16. Bacteria.
17. Rodent and insect infestation.
19. Electrical current.
20. High speed operation.
21. Improper lubrication.
22. Unusual wear or other misuse.
23. Contact between incompatible materials.
24. Misalignment.
25. Excessive weathering.
27. Improper shipping or handling.
28. Theft.
29. Vandalism.

END OF SECTION 01 73 00
SECTION 01 77 00
CLOSEOUT PROCEDURES

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:

1. Substantial Completion procedures, including Notice of Completion and Final Inspection procedures.
2. Occupancy procedures, including Notice of Approval of Occupancy/Use and University Supplemental Notice of Occupancy and Use List.
3. Final Acceptance procedures, including Pre-Acceptance Checklist and University Supplemental Building/Project Acceptance List.
4. Inspections after completion.
5. Warranties.
6. Final cleaning.
7. Repair of the Work.

B. Related Requirements:
   1. Section 01 73 00 "Execution" for progress cleaning of Project site.
   2. Section 01 78 23 "Operation and Maintenance Data" for operation and maintenance manual requirements.
   3. Section 01 78 39 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
   4. Section 01 79 00 "Demonstration and Training" for requirements for instructing University's personnel.

1.3 ACTION SUBMITTALS

A. Product Data: For cleaning agents.

B. Contractor's List of Incomplete Items: Initial submittal at Notice of Completion.

C. Certified List of Incomplete Items: Final submittal at Final Acceptance.

1.4 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

C. Field Report: For pest control inspection.
1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.6 NOTICE OF COMPLETION AND SUBSTANTIAL COMPLETION PROCEDURES

A. Procedures and Submittals Prior to Notice of Completion: Complete and submit all of the following items prior to submitting Notice of Completion to Architect/Engineer. Include Contractor’s comprehensive list of items to be completed, corrected or not in compliance with the Drawings and Specifications.

1. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's preliminary punch list), indicating the value of each item on the list and reasons why the Work is incomplete.

2. Building Inspection Record: Submit completed record with all required corrections noted.


4. Final Completion Schedule: Submit schedule for performing and completing all work indicated on the Contractor’s list of incomplete items.

5. Submit sustainable design documentation.

6. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.

7. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.

8. Submit test/adjust/balance records.

B. Final Inspection: Submit Notice of Completion to Architect/Engineer. Upon receipt, Architect/Engineer and University will review and if all items on the University Supplemental Notice of Completion Checklist are complete will, within the timeframe required by the Contract, schedule and make an inspection of the Project to determine whether the Work is substantially complete.

1. Final Punch List: Based on the inspection, Architect/Engineer will prepare a final punch list of work to be completed, work not in compliance with the Drawings or Specifications, and unsatisfactory work for any reason.

2. Re-inspection: If the cumulative number of items identified on the final punch list prevents a determination that the work is substantially complete, complete those items and when complete resubmit Notice of Completion. Upon receipt of resubmittal, Architect/Engineer and University will then schedule and make a re-inspection of the Project to determine whether the Work is substantially complete.

C. Notice of Substantial Completion: When inspection of the Work indicates that the Project is substantially complete and all other Contract provisions required for substantial completion have been satisfied, Architect/Engineer will issue a Notice of Substantial Completion (State Form SBP-07).

1.7 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor or as approved by Architect/Engineer.

2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.

3. Include the following information at the top of each page:
   a. Project name.
   b. Date.
   c. Name of Architect/Engineer.
   d. Name of Contractor.
   e. Page number.

4. Submit list of incomplete items in the following format:
   a. MS Excel and PDF electronic file. Architect/Engineer will return annotated file.

1.8 OCCUPANCY PROCEDURES

A. Procedures and Submittals Prior to Occupancy: Complete and submit all items on both State Form SBP-01 “Notice of Approval of Occupancy/Use” and University Supplemental Notice of Occupancy and Use List.

1.9 FINAL ACCEPTANCE PROCEDURES

A. Procedures and Submittals Prior to Final Acceptance: Complete and submit all items on both State Form SBP-05 “Pre-Acceptance Checklist” and University Supplemental Building/Project Acceptance List.

B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 business days prior to the date the work will be completed and ready for final inspection and tests. On receipt of request, Architect/Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect/Engineer will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.10 SETTLEMENT AND FINAL PAYMENT

A. Submit and complete all of the following as a condition precedent to settlement and final payment:

1. All guarantees and warranties.
2. All statement to support local sales tax refunds, if any.
3. Three (3) sets of operation and maintenance manuals.
4. One (1) set of as-built Contract Documents showing all job changes.
5. All demonstration and training completed in accordance with Section 01 79 00.
6. All punch list items documented as complete.

B. Final Certificate of Payment: Submit in accordance with the requirements of Section 01 29 00 “Payment Procedures.”
1.11 INSPECTIONS AFTER COMPLETION

A. Warranty/Guarantee Inspections: During the warranty period, accompany Architect/Engineer and University Representative, and participate in inspection(s) of the Project to identify defective and deficient work at intervals and as required by the Contract.

B. List of Deficient or Defective Work: Within 10 business days of inspection, Architect/Engineer will provide Contractor with a list of items requiring correction.

C. Remedial Work: Upon receive of itemized list, immediately correct and remedy deficiencies and defects in a manner satisfactory to the Architect/Engineer and University.

1.12 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties to the Architect/Engineer prior to advertisement of the Notice of Contractor's Settlement. If the Notice of Acceptance designates a commencement date for warranties other than the date of Notice of Acceptance for the Work, or a designated portion of the Work, submit written warranties upon request of the Architect.

B. Partial Occupancy: When a designated portion of the Work is completed and occupied or used by the University, by separate agreement with the Contractor during the construction period, submit properly executed warranties to the Architect/Engineer within fifteen (15) calendar days of completion of that designated portion of the Work.

C. Special Warranties: When a special warranty is required to be executed by the Contractor, or the Contractor and a Subcontractor, supplier or manufacturer, prepare a written document that contains appropriate terms and identification, ready for execution by the required parties. Submit a draft to the University through the Architect/Engineer for approval prior to final execution. Refer to individual Specification Sections for specific requirements for special warranties.

D. Form of Submittal: Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.

1. Number of Copies: Two.
2. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
3. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
4. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
5. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

E. Provide additional copies of each warranty to include in operation and maintenance manuals.

F. List of Extended Warranties: Provide a comprehensive list of all manufacturers’ standard and special warranties with duration greater than one year after Notice of Acceptance. Organize list into an orderly sequence based on table of contents of the Project Manual.
PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

1. Use cleaning products that comply with Green Seal’s GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.
2. Do not use sweeping compounds on concrete floors that will leave residue affecting finish floor materials.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations immediately prior to Occupancy for entire Project or for a designated portion of Project:
   a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
   b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
   c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
   d. Remove tools, construction equipment, machinery, and surplus material from Project site.
   e. Remove snow and ice to provide safe access to building.
   f. Clean exposed exterior and interior finishes to a dirt-free condition, free of grease, dust, stains, films, fingerprints, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
   g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
   h. Sweep concrete floors broom clean in unoccupied spaces.
   i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
   j. Power scrub and power buff resilient flooring surfaces, tile and fluid-applied flooring.
   k. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
   l. Remove labels that are not permanent.
   m. Wipe surfaces of mechanical and electrical equipment, elevator equipment where applicable, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
n. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
o. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
p. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.


q. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
r. Clean food service equipment to sanitary condition acceptable for intended food service use and approved by authority having jurisdiction.
s. Leave Project clean and ready for occupancy.

C. Pest Control: Comply with pest control requirements in Section 01 50 00 "Temporary Facilities and Controls." Prepare written report.

3.2 REPAIR OF THE WORK

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

B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.

1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that that already show evidence of repair or restoration.

a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.

3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

3.3 ATTACHMENTS

A. Samples of the following forms are appended to this Section for reference following End of Section 01 77 00:

1. University of Colorado Denver | Anschutz Medical Campus Supplemental Notice of Occupancy and Use List.

2. University of Colorado Denver | Anschutz Medical Campus Supplemental Building / Project Acceptance List.
END OF SECTION 01 77 00
In addition to completing Notice of Approval of Occupancy / Use (SBP-01), the following items must be completed before Occupancy is approved:

<table>
<thead>
<tr>
<th>Activity</th>
<th>Date Completed</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Final and formal address posted on the building entries.</td>
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<tr>
<td>2. A copy of the Contractor’s in-progress red line “as-built” drawings has been given to BMO representative &amp; a 2nd copy is provided for Projects plan room. This is to include landscape drawings showing irrigation installation.</td>
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<tr>
<td>3. Maintenance, operations and spare parts manuals on all installed equipment.</td>
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<tr>
<td>4. Notice of Partial Substantial Completion concerning roles/responsibilities of University and Contractor for security, maintenance, heat, utilities reviewed and accepted.</td>
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<tr>
<td>5. Manufacturer maintenance, operations and spare parts manuals for fixtures, mechanical, electrical and plumbing.</td>
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<tr>
<td>6. Hardware-maintenance, operations and spare parts manuals for doors &amp; locks, including roll up doors.</td>
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<tr>
<td>7. Warranty Dates and Contact list for all Contractors and Suppliers given to BMO.</td>
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<tr>
<td>8. Transfer utility account from Contractor to Facilities Operations.</td>
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<tr>
<td>9. Site plan to include first floor main isolation locations and plans for each floor to include main utility shutoffs, for utilities to include water, electrical, steam, sewer, fuel supply, telecom, fiber optic and gasses, identified on a set of drawings.</td>
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<tr>
<td>10. If Commissioning Report is completed, BMO has reviewed/commented, including electrical, plumbing, mechanical/ HVAC.</td>
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<tr>
<td>11. All Contractor provided equipment has new filters &amp; construction filters removed.</td>
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<tr>
<td>12. Not Used</td>
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<tr>
<td>13. Elevator equipment rooms insulated and space conditioned for control system requirements.</td>
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<tr>
<td>15. FSS has been provided with copy of Building Department testing and inspection report for window washing equipment.</td>
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<tr>
<td>16. Roof walking pads to access equipment are installed.</td>
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<tr>
<td>17. PM to communicate to fire department via Life Safety Officer that building has transitioned to BMO. Alarms at Anschutz Medical Campus report to University Police Dispatch and at Downtown report to designated monitoring company.</td>
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</tbody>
</table>

19. Training for BMO and FSS on installed equipment and systems is completed.

20. Equipment keys and locks transitioned to Operations, including fire panels, electrical panels, directories and generator panels. Construction cores removed and replaced with permanent cores.

21. Access control pathways and junction boxes for installed doors, gates, loading docks and roof access complete. *All wiring and hardware completed and electronic security access controls in place and tested by University Electronic Security.*

22. EH&S is provided, as applicable for project, with fume hood certification, water testing certification, hazardous waste compliance certification, radiation compliance certification, BSL3 certification, and all other specialty equipment certification.

23. PM notifies University Risk Management that project is transferring to University and notifies Contractor that it can eliminate Builders Risk Insurance.

24. Not Used

25. Not Used

26. Elevator tools, including hand tools, computer, proprietary and operational software is received and confirm 1-year service from date of acceptance.

27. All computers and software required in drawings and specs. are received, including for BAS, Energy and Lighting, Fuel Systems, and Power Management, and any specialty software and alarm codes for operating systems.

28. For all areas to be transferred to University, all waste and debris removed; floor and wall surfaces clean and in good repair; ceiling surfaces clean, unmarked, in place; site, including sidewalks, cleared of debris and construction equipment; and roof is clear of all materials and debris.

29. Water chlorination and testing complete and provided by PM to Chief Building Official and BMO via BMO Rep.

30. Toilet accessories are in place that meet custodial contract.

31. Trash receptacles outside the building are in place

*Highlighted items are not the responsibility of Contractor but PM and BMO Rep must ensure these are completed and operational prior to occupancy and use.*

Mark N/A by item if it is not applicable to project

3.1.12
**Supplemental Building / Project Acceptance List**

**Project Name & Number:** ____________________________________________________________

**Contractor:** ______________________________________________________________________

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In addition to completing Pre-Acceptance Checklist (SBP-05), the following items must be completed before Final Acceptance.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Date Completed</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Review State Buildings Pre-Acceptance check list &amp; Notice of Approval of Occupancy / use form with BMO rep &amp; confirm agreement with status</td>
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</tr>
<tr>
<td>*2. Establish list of post construction change orders &amp; track separately from basic project until items are complete – call it Phase 2 to avoid delay on basic project</td>
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<tr>
<td>3. O &amp; M Manuals given to BMO Representative and BMO Archivist (2 hard copies and 1 electronic total)</td>
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<tr>
<td>*4. Record Documents – a hard copy of plans and specifications are provided for plan room &amp; given to BMO &amp; electronic auto cad &amp; specs are given to Archive Officer (Art Steinman) this is to include landscape drawings showing irrigation installation.</td>
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<tr>
<td>*5. Final Site Walk is completed with University Grounds Supervisor. Drain barriers are removed and storm drains cleared. MS4 storm water plan, CDPHE permits, and evidence of final closeout received by Project Manager and all copied to University Engineering Division.</td>
<td></td>
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<tr>
<td>*/**6. <strong>Move-related work items complete including physical move, tours (occupants &amp; police), mail, phone &amp; electrical hook ups for equipment &amp; furniture systems complete &amp; freezers enrolled in University freezer program.</strong></td>
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<tr>
<td>7. If exterior work is applicable: Landscape – Include a walk through with University Grounds for 1) new &amp; established 1-year service date; 2) existing damaged landscape is repaired; and 3) irrigation – zone control test is complete.</td>
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<tr>
<td>8. Attic stock, matches spec. requirements, is located in secured location, and is inventoried.</td>
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<tr>
<td>9. Electrical system one line diagram framed and mounted in electrical room.</td>
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<tr>
<td>10. Spare fire suppression heads in cabinets and tool: cabinet in main electrical room includes one complete set of spare fuses for major equipment.</td>
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<tr>
<td>11. Contractor keys issued by University BMO returned to University Key Shop via PM/ BMO Rep.</td>
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<tr>
<td>12. Interior Finishes Binder given to the University Project Manager: (Two hard copies)</td>
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<tr>
<td>13. Not Used</td>
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<tr>
<td>14. Not Used</td>
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</tr>
</tbody>
</table>
15. Safety grating in pipe chases in place.

16. Signs in place including monument sign, building exterior and site signage and building interior signage.

17. All applicable reports, including Air Emission reports; Sewer Reports, including for process diverters, traps and collection tanks; Fuel Storage Tank and Detection reports; and Water System tests and reports provided to BMO via PM and BMO Rep.

18. Not Used

19. Not Used

20. Not Used

21. Not Used

22. If commissioning is included for project, Commissioning Agent certification is received by BMO via PM and BMO Rep.

<table>
<thead>
<tr>
<th>University Project Manager</th>
<th>Date</th>
<th>University BMO Rep.</th>
<th>Date</th>
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<tbody>
<tr>
<td>(sign &amp; print name)</td>
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<td>(sign &amp; print name)</td>
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<thead>
<tr>
<th>University FSS</th>
<th>Date</th>
<th>University Downtown Rep (if necessary)</th>
<th>Date</th>
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<td>(sign &amp; print name)</td>
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</tbody>
</table>

*Warranty dates are not subject to completion of these items by contract
** Highlighted items are not the responsibility of Contractor but PM and BMO Rep must ensure these are completed and operational prior to occupancy and use.
Mark N/A by item if it is not applicable to project
SECTION 01 78 23

OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Operation and maintenance documentation directory.
2. Systems, subsystems, and equipment operation and maintenance manuals.
3. Product maintenance manuals.
4. Emergency manuals.
5. Framed operating and maintenance instructions.

B. Related Requirements:

1. Section 01 33 00 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
2. Section 01 91 13 "General Commissioning Requirements" for verification and compilation of data into operation and maintenance manuals.

1.3 DEFINITIONS

A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 CLOSEOUT SUBMITTALS

A. Schedule: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 30 calendar days before commencing demonstration and training. Architect/Engineer will return copy with comments.

1. Correct or revise each manual to comply with Architect/Engineer's comments. Submit copies of each corrected manual within 15 calendar days of receipt of Architect/Engineer's comments and prior to commencing demonstration and training.

B. Format: Submit operations and maintenance manuals in the following format:

1. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Architect/Engineer.
a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
b. Compile entirely from documents with searchable text.
c. Enable inserted reviewer comments on draft submittals.

2. Paper copies. Assemble in accordance with the requirements of this Section.
   a. Submit three final copies, one to be retained by the Architect/Engineer and two to be retained by the University.

C. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 30 calendar days before commencing demonstration and training. Architect/Engineer will return copy with comments.
   1. Correct or revise each manual to comply with Architect/Engineer's comments. Submit copies of each corrected manual within 15 calendar days of receipt of Architect/Engineer's comments and prior to commencing demonstration and training.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Intent: Prepare data in form of an instructional manual for use by University personnel.

B. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
   1. Title page.
   2. Table of contents.

C. Title Page: Include the following information:
   1. Subject matter included in manual.
   2. Name and address of Project.
   3. Name and address of University.
   4. Date of submittal.
   5. Name and contact information for Contractor.
   6. Name and contact information for Construction Manager.
   7. Name and contact information for Architect/Engineer.
   8. Name and contact information for Commissioning Authority.
   9. Names and contact information for major consultants to the Architect/Engineer that designed the systems contained in the manuals.
   10. Cross-reference to related systems in other operation and maintenance manuals.

D. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
   1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
E. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

F. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

G. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.

H. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.

1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in minimum 1 inch and maximum 2 inch thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
   a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
   b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents, and indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.

2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.

3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment.


5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
   a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
   b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.2 SYSTEMS, SUBSYSTEMS AND EQUIPMENT OPERATION AND MAINTENANCE MANUALS

A. General: Provide operation and maintenance manuals where indicated in individual Specification Section and the following:
1. Heating, ventilating and air-conditioning equipment and systems.
2. Plumbing equipment and systems.
3. Special piping equipment and systems.
4. Electrical distribution systems.
5. Standby generator systems.
6. Communications systems.
7. Fire alarm and detection systems.
8. Underground sprinkler systems.
10. Food service equipment.
11. Elevators.
12. Other special construction and conveying systems.

B. Operation Content: In addition to requirements in this Section, include operation data required in individual Specification Sections.

1. Additional Operation Content Required:
   b. Performance and design criteria if Contractor has delegated design responsibility.
   c. Operating standards.
   d. Operating procedures.
   e. Operating logs.
   f. Wiring diagrams.
   g. Control diagrams.
   h. Piped system diagrams.
   i. Precautions against improper use.
   j. License requirements including inspection and renewal dates.

2. Descriptions: Include the following:
   a. Product name and model number. Use designations for products indicated on Contract Documents.
   b. Manufacturer's name.
   c. Equipment identification with serial number of each component.
   d. Equipment function.
   e. Operating characteristics.
   f. Limiting conditions.
   g. Performance curves.
   h. Engineering data and tests.
   i. Complete nomenclature and number of replacement parts.

3. Operating Procedures: Include the following, as applicable:
   a. Startup procedures.
   b. Equipment or system break-in procedures.
   c. Routine and normal operating instructions.
   d. Regulation and control procedures.
   e. Instructions on stopping.
   f. Normal shutdown instructions.
   g. Seasonal and weekend operating instructions.
   h. Required sequences for electric or electronic systems.
   i. Special operating instructions and procedures.
4. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.


C. Maintenance Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.

1. Source Information: Provide the following information in a list for each product included in manual:
   a. Name, address, and telephone number of Installer or supplier and maintenance service agent.
   b. Name, address, and telephone number of local source for supply of replacement parts.
   c. Name, address, and telephone number of maintenance contractor, where appropriate.
   d. Cross-reference Specification Section number and title.
   e. Drawing or schedule designation or identifier where applicable.

2. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
   a. Standard maintenance instructions and bulletins.
   b. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
   c. Identification and nomenclature of parts and components.
   d. List of items recommended to be stocked as spare parts.

3. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
   a. Test and inspection instructions.
   b. Troubleshooting guide.
   c. Precautions against improper maintenance.
   d. Disassembly; component removal, repair, and replacement; and reassembly instructions.
   e. Aligning, adjusting, and checking instructions.
   f. Demonstration and training video recording, if available.

4. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
   a. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
   b. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

5. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

6. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

7. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
2.3 PRODUCT MAINTENANCE MANUALS

A. Content: Organize manual into a separate section for each product, material, and finish. Separate into two manuals: one for exterior moisture protection products and those exposed to weather and one for interior products. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

B. Source Information: Provide the following information for each product included in manual:

1. Name, address, and telephone number of Installer or supplier and maintenance service agent.
3. Drawing or schedule designation or identifier where applicable.

C. Product Information: Include the following, as applicable:

1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
5. Reordering information for specially manufactured products.

D. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

2.4 EMERGENCY MANUALS

A. Content: Organize manual into a separate section for each of the following:

1. Type of emergency.
2. Emergency instructions.
3. Emergency procedures.

B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:

1. Fire.
2. Flood.
5. Power failure.
7. System, subsystem, or equipment failure.
8. Chemical release or spill.

C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of University's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

D. Emergency Procedures: Include the following, as applicable:
   1. Instructions on stopping.
   2. Shutdown instructions for each type of emergency.
   3. Operating instructions for conditions outside normal operating limits.
   4. Required sequences for electric or electronic systems.
   5. Special operating instructions and procedures.

2.5 Framed Operating and Maintenance Instructions

A. All mechanically and electrically operated equipment and controls shall be provided with legible and complete wiring diagrams, schematics, operating instructions, and pertinent preventative maintenance instructions in a sturdy frame with clear glass or plastic cover. Use non-fading, permanent media.

B. Locate frames in the same room or service enclosure as equipment, or in the nearest mechanical or electrical room.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 78 23
SECTION 01 78 39

PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for project record documents, including the following:
   1. Record Drawings.
   2. Record Specifications.
   3. Record Product Data.
   4. Record Samples.
   5. Miscellaneous record submittals.

B. Related Requirements:
   1. Section 01 73 00 "Execution" for final property survey.
   2. Section 01 77 00 "Closeout Procedures" for general closeout procedures.
   3. Section 01 78 23 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.3 CLOSEOUT SUBMITTALS

A. General: Submit record drawings with duplicate original transmittal letters containing:
   1. Date.
   2. Project title and number.
   3. Contractor’s name and address.
   4. Certification that each document as submitted is complete and accurate.
   5. Signature of authorized representative of the Contractor.

B. Record Drawings: Submit copies of record Drawings as follows:
   1. Submit three paper-copy sets of marked-up record prints, two copies will be retained by the University and one copy retained by the Architect/Engineer.
   2. Submit three paper-copy sets and three digital copies on CD of electronic files for all delegated-design submittals. Two copies will be retained by the University and one copy retained by the Architect/Engineer.

C. Record Specifications: Submit three paper copies of Project's Specifications, including addenda and contract modifications. Two copies will be retained by the University and one copy retained by the Architect/Engineer.
D. Record Product Data: Submit three paper copies of each submittal. Two copies will be retained by the University and one copy retained by the Architect/Engineer.

1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.

E. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit three paper copies of each submittal. Two copies will be retained by the University and one copy retained by the Architect/Engineer.

F. Interior Finishes Binder: Three copies. Two copies will be retained by the University and one copy retained by the Architect/Engineer.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.

1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.

   a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
   b. Accurately record information in an acceptable drawing technique.
   c. Record data as soon as possible after obtaining it.
   d. Record and check the markup before enclosing concealed installations.
   e. Cross-reference record prints to corresponding archive photographic documentation.
   f. Mark using line types and symbols conforming to Contract Documents.

2. Content: Types of items requiring marking include, but are not limited to, the following:

   a. Dimensional changes to Drawings.
   b. Revisions to details shown on Drawings.
   c. Depths of foundations below first floor.
   d. Locations and depths of underground utilities referenced to permanent surface improvements.
   e. Revisions to routing of piping and conduits.
   f. Revisions to electrical circuitry.
   g. Actual equipment locations.
   h. Duct size and routing.
   i. Locations of concealed internal utilities referenced to visible and accessible features of structure.
   j. Locations of concealed valves, dampers, controls, balancing devices, junction boxes, cleanouts, and other items requiring access or maintenance.
   k. Changes made by Change Order.
   l. Changes made following Architect/Engineer's written orders.
   m. Details not on the original Contract Drawings.
   n. Field records for variable and concealed conditions.
o. Record information on the Work that is shown only schematically.

3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.

4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.

5. Mark additional information important to University that was either shown schematically or omitted from original Drawings.

6. Note Change Order numbers, and similar identification, where applicable.

B. Record Delegated Design Electronic Files: For all delegated design submittals, including but not limited to landscape irrigation, fire alarm and fire sprinkler plans, prepare electronic files in full compliance with University of Colorado Denver | Anschutz Medical Campus Guidelines and Design Standards, Part 1.0, Paragraph “Drawing Production Standards.”

C. Identification: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.

2. Identification: As follows:
   a. Project name.
   b. Date.
   c. Designation "PROJECT RECORD DRAWINGS."
   d. Name of Architect/Engineer.
   e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.

1. Give particular attention to substitutions, selection of options, and similar information on concealed products and installations that cannot be readily identified and recorded later.

2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.

3. Note related Change Orders where applicable.

4. Maintain one complete copy of all Addenda, Change Orders and other written change documents in printed form during construction.

2.3 RECORD PRODUCT DATA

A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.

2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.

3. Note related Change Orders, record Specifications, and record Drawings where applicable.

B. Directory: Include record Product Data directory organized by Specification Section number and title.
C. **Product List:** Update and record any changes to Product List submitted in accordance with Section 01 60 00 “Product Requirements”, including any changes to brand, model, subcontractor, or Installer so that final list reflects materials, equipment and systems incorporated into the Work.

### 2.4 RECORD SAMPLES

A. Prior to Final Acceptance, meet with University Project Manager and Architect/Engineer at site to review and identify which submitted samples maintained during the progress of the Work are to be transmitted to the University.

B. Deliver selected samples to storage area identified by University.

C. **Finishes Binder:** Three-ring notebook or notebooks, organized by Specification Section number, providing a listing and description of all material finishes on the Project and including a minimum 6 inch by 6 inch sample thereof to accompany the description. Accompany each material selection indicated with the following:

1. Manufacturer and product name.
2. Pattern name and number, as applicable.
3. Color name, as applicable.
4. Any additional information required to order replacement product.

### 2.5 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

1. Include manufacturer’s certifications, field test record, copies of permits, licenses, certifications, inspection reports, releases, notices, receipts for fee payments and similar documents.

B. **Directory:** Include miscellaneous record submittals directory organized by Specification Section number and title.

### PART 3 - EXECUTION

### 3.1 RECORDING AND MAINTENANCE

A. **Recording:** Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project. Update at least weekly.

B. **Maintenance of Record Documents and Samples:** Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect/Engineer's and University’s reference during normal working hours.

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**END OF SECTION 01 78 39**
SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Items indicated to be removed and salvaged remain Owner's property. Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse. Include fasteners or brackets needed for reattachment elsewhere.

B. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

C. It is not expected that hazardous materials will be encountered in the Work. If hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with EPA regulations and with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 DEMOLITION

A. Maintain services/systems indicated to remain and protect them against damage during selective demolition operations. Before proceeding with demolition, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of the building.

B. Locate, identify, shut off, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.

C. Refrigerant: Remove refrigerant from mechanical equipment to be selectively demolished according to 40 CFR 82 and regulations of authorities having jurisdiction.

D. Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
E. Protect walls, ceilings, floors, and other existing finish work that are to remain. Erect and maintain dustproof partitions. Cover and protect furniture, furnishings, and equipment that have not been removed.

F. Provide temporary weather protection to prevent water leakage and damage to structure and interior areas.

G. Requirements for Building Reuse:
   1. Maintain existing building structure (including structural floor and roof decking) and envelope (exterior skin and framing, excluding window assemblies and nonstructural roofing material) not indicated to be demolished; do not demolish such existing construction beyond indicated limits.
   2. Maintain existing interior nonstructural elements (interior walls, doors, floor coverings, and ceiling systems) not indicated to be demolished; do not demolish such existing construction beyond indicated limits.

H. 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.

I. Remove demolition waste materials from Project site and legally dispose of them in an EPA-approved landfill. Do not burn demolished materials.

J. 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 024119
SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data and color Samples.

B. EXTENDED WARRANTY: Provide a written two-year warranty, signed by Contractor and sealant installer, guaranteeing all interior joints detailed within the Vivarium to be water and air tight for a period of not less than two (2) years from date of the Letter of Acceptance of the Work by the University.

C. Environmental Limitations: Do not proceed with installation of joint sealants when ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (4.4 deg C).

PART 2 - PRODUCTS

2.1 JOINT SEALANTS

A. Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for Use NT.
   1. Use: For joints in vertical surfaces, except at Vivarium.
   2. Products: Subject to compliance with requirements, provide one of the following:
      a. Dow Corning Corporations; 790
      b. GE Advanced Materials – Silicones; SilPruf LM SCS2700.
      c. Tremco Incorporated; Spectrem 1.

B. Mildew-Resistant, Single-Component, Acid-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT, formulated with fungicide.
   1. Use: For joints in restrooms, janitor’s closets and other areas subject to continued moisture exposure or high humidity, including door frames and all static joints in ABSL and animal facilities (Vivariums).
   2. Products: Subject to compliance with requirements, provide one of the following:
      a. BASF Building Systems; Omniplus
      b. Dow Corning Corporation; 786 Mildew Resistant
      c. GE Advanced Materials – Silicones; Sanitary SCS1700.
      d. Tremco Incorporated; Tremsil 200 Sanitary.

C. Compatibility: Provide joint sealants, joint fillers, and other related materials that are compatible with one another and with joint substrates under service and application conditions.
2.2 MISCELLANEOUS MATERIALS

A. Provide sealant backings of materials 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.

B. Cylindrical Sealant Backings: ASTM C 1330, of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

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.

PART 3 - EXECUTION

3.1 INSTALLATION

A. SPECIAL INSTALLATION REQUIREMENTS AT VIVARIUM: Provide the following for the Vivarium and provide mildew resistant sealant listed above at all conditions listed below:
   1. Ceilings: Fully seal all joints at access panels, light fixtures, electrical devices, mechanical devices, fire protection devices, etc.
   2. Walls: Fully seal all joints, including but not limited to, joints between finished wall surface and door and window frames, power boxes, plug mold, wire mold, alarm and sensor boxes, access panels, electrical devices, plumbing devices, mechanical devices, fire protection devices, wall bumper and mounting plates, wall plates, wall-mounted equipment, window sills and jambs, and all joints between FRP panels.
   3. Wall and ceiling penetrations: Completely seal all penetrations, including but not limited to, joints between finished surface and electrical conduits, electrical plugs and switches, light fixtures, cover plates, piping for water, gas, vacuum, gas, soil and waste lines, mechanical ducts, registers, etc.

B. Comply with ASTM C 1193.

C. Install sealant backings to support sealants during application and to produce cross-sectional shapes and depths of installed sealants that allow optimum sealant movement capability.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

END OF SECTION 079200
SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS
   A. Submittals: Product Data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS
   A. Fire-Resistance-Rated Assemblies: Provide materials and construction identical to those tested in assemblies per ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
   B. STC-Rated Assemblies: Provide materials and construction identical to those tested in assemblies per ASTM E 90 and classified per ASTM E 413 by a qualified independent testing and inspecting agency.

2.2 PRODUCTS
   A. Provide in maximum lengths available to minimize end-to-end butt joints.
   B. Interior Gypsum Board:
      1. Gypsum board, Type X: Provide 5/8 inch thick, typical unless noted otherwise.

2.3 ACCESSORIES
   A. Trim Accessories: ASTM C 1047, formed from galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet.
      1. Provide cornerbead at outside corners unless otherwise indicated.
      2. Provide LC-bead (J-bead) at exposed panel edges.
      3. Provide control joints where indicated.
   B. Joint-Treatment Materials: ASTM C 475/C 475M.
      1. Joint Tape: Paper unless otherwise recommended by panel manufacturer.
      2. Joint Compounds
      3. Skim Coat: For final coat of Level 5 finish
1. Sealants shall have a VOC content of 250 g/L or less.
2. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Sound-Attenuation Blankets: ASTM C 665, Type I (unfaced).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install gypsum board to comply with ASTM C 840.
   1. Isolate gypsum board assemblies from abutting structural and masonry work. Provide edge trim and acoustical sealant.
   3. Multilayer Fastening Methods: Fasten base layers and face layer separately to supports with screws.

B. Fire-Resistance-Rated Assemblies: Comply with requirements of listed assemblies.

C. Finishing Gypsum Board: ASTM C 840.
   1. At concealed areas, unless a higher level of finish is required for fire-resistance-rated assemblies, provide Level 1 finish: Embed tape at joints.
   2. Unless otherwise indicated, provide Level 4 finish: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges.

END OF SECTION 092900
SECTION 096723 – RESINOUS FLOORING

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Product data: for each type of product indicated, include manufacturer's technical data, application instructions, and recommendations for each resinous flooring component required.

B. Samples for selection / matching

C. Design requirements:
   1. Provide troweled-on, skid resistant, antimicrobial, chemically resistant epoxy flooring at vivariums and other similar functional areas.
   2. Provide continuous, seamless, sealed flooring with a coved wall base of height to match existing.

1.2 SUBMITTALS

A. Review shop drawings for match and possible waste factors in ordering required amounts. Provide copy of approved shop drawings on job site during installation.

B. Verification samples: Submit two full size samples illustrating color.

C. Manufacturer’s Installation Instructions: Indicate special procedures and conditions requiring special attention.

1.3 QUALITY ASSURANCE

A. Manufacturer’s Qualifications
   1. 5 year documented experience in manufacturing of carpet tile.

B. Installer Qualifications
   1. Flooring contractor must be certified by the carpet manufacturer prior to bid.
   2. Flooring contractor to be a specialty contractor normally engaged in this type of work and has prior experience in the installation of carpet tiles.
   3. Flooring contractor will be responsible for proper installation, including floor testing and preparation, as specified by the carpet manufacturer and job conditions herein.

C. Single source responsibility: Obtain each type of carpet from one source and by a single manufacturer.

1.4 DELIVERY, STORAGE AND HANDLING
A. Deliver materials to the site in manufacturer’s original packaging listing manufacturer’s name, product name, identification number, and related information.

B. Store in a dry location, between 60 degrees F and 80 degrees F and a relative humidity below 65%. Protect from damage and soiling.

C. Store materials in area of installation for minimum period of 48 hours prior to installation.

1.5 PROJECT CONDITIONS

A. Sub floor preparation is to include all required work to prepare the existing floor for installation of the product as specified in this document and Manufacturer’s installation instructions.

B. Environmental limitations: comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.

1.6 WARRANTY

A. Warranty to be sole source responsibility of the Manufacturer. Second source warranties and warranties that involve parties other than the resinous flooring manufacturer are unacceptable.

B. If the product fails to perform as warranted when properly installed and maintained, repair or replace the affected area at the discretion of the manufacturer.

C. Provide warranty for a specifically defined non-prorated period of 15 years to cover the following. “Lifetime” warranties are not acceptable.

PART 2 – PRODUCTS

2.1 MATERIALS, GENERAL – RESINOUS FLOORING

A. High performance resinous flooring and integral cove base:

1. Basis of design product: Subject to compliance with requirements, provide Stonhard, Stonclad GS with GS4 topcoat or comparable product to match existing.

2. System characteristics:

   a. Wearing surface: textured for slip resistance

   b. Overall system thickness: 1/4"

3. System components:

   a. Body coat(s):

      1. Resin: Epoxy

      2. Formulation description: 100 percent solids

      3. Application method: Troweled or screeded
b. Topcoat: sealing or finish coats

1. Resin: Epoxy
2. Formulation description: 100 percent solids
3. Type: Clear
4. Finish: To match existing
5. Number of coats: One

4. System chemical resistance: coordinate with the university project manager for a list of reagents likely to contact resinous flooring during in-service use.

B. Accessories:

1. Primer as recommended by manufacturer

PART 3 – EXECUTION

3.1 EXAMINATION

A. Prepare sub-floor and walls to comply with criteria established in Manufacturer’s installation instructions. Use only preparation materials that are acceptable to the manufacturer.

1. Remove all deleterious substances from substrate(s) that would interfere with or be harmful to the installation.

2. Remove sub-floor ridges and bumps. Fill cracks, joints, hole and other defects.

B. Verify that sub floor is smooth and flat within specified tolerances and ready to receive resinous flooring.

C. Verify that substrate surface is dust free and free of substances that would impair bonding of product to the floor/wall.

D. There will be no exceptions to the provisions stated in the manufacturer’s installation instructions.

3.2 INSTALLATION, GENERAL

A. Resinous flooring to match dimensions and geometry of existing flooring and cove base with neat edges at seam between existing and new resinous flooring.

3.3 TESTING, CLEANING AND CERTIFICATION

A. Clean flooring/cove surfaces per manufacturer’s instructions.

B. General: prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry substrate for resinous flooring application.
C. Concrete substrates: provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.

1. Roughen concrete substrates as follows:
   a. Grind surfaces with an apparatus that abrades the concrete surface to a profile as specified by system application guide.
   b. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written instructions.

D. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.

END OF SECTION 096723
PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Fiberglass reinforced plastic (FRP) paneling for wall and ceiling surfaces, including trim accessories.

1.2 REFERENCES

A. General: Standards listed by reference form a part of this specification section. Standards listed are identified by issuing authority, abbreviation, designation number, title or other designation. Standards subsequently referenced in this Section are referred to by issuing authority abbreviation and standard designation.

B. ASTM International:


C. FM Global (FM) (www.fmglobal.com):

1. ANSI FM Approval 4880 – Class 1 Fire Rating of Insulated Wall or Wall and Roof/Ceiling Panels, Interior Finish Materials or Coatings, and Exterior; Wall Systems.

D. UL (www.ul.com):

1. UL 2818 – GREENGUARD Certification Program For Chemical Emissions For Building Materials, Finishes And Furnishings.

E. Crane Composites (Inspired by Kemlite):

1. Installation Guide For FRP Panels #6876.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meetings: Conduct preinstallation meeting to clarify Project requirements, substrate conditions, manufacturer’s installation instructions and manufacturer’s warranty requirements.

B. Preinstallation mock-ups: Contractor to provide (2) wall and (2) ceiling mock-ups as selected by University and Architect. Mock-ups will be provided in different locations to illustrate two typical conditions at wall and ceiling. Finished mock-ups to be approved by University and Architect and will serve as a reference guide to construction scope and quality.

C. Review the Following:

1. Materials.
2. Preparation.
3. Installation.
4. Field quality control.
5. Adjusting.
6. Cleaning.
7. Protection.
8. Coordination with other Work.

1.4 ACTION SUBMITTALS

A. Product Technical Data: For each type of product required.

B. Shop Drawings: Showing layout, profiles and product components, including anchorage, accessories, finish colors, patterns and textures. Indicate location and dimension of joints and fastener attachment.

C. Samples: Selection and verification samples for finishes, colors and textures. Submit two samples of each type of panel, trim and fastener.

D. Certificates: Product certificates signed by manufacturer certifying materials comply with specified performance characteristics, criteria and physical requirements.

E. Test and Evaluation Reports: Showing compliance with specified performance characteristics and physical properties.

F. Manufacturer’s Instructions: Manufacturer’s Installation Guide for FRP #6876.

G. Qualifications Statements: For manufacturer and installer.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For installed products including maintenance methods and precautions against cleaning materials and methods detrimental to finishes and performance.

B. Warranty: Warranty documents required in this section.

1.6 MAINTENANCE MATERIAL

A. Extra Materials: Deliver to Owner extra materials from same production run as products installed. Package products with protective covering and identify with descriptive labels. Comply with Division 01 Closeout Submittals Section.

   1. Quantity: Furnish quantity of (3) extra sheets.
   2. Delivery, Storage and Protection: Comply with Owner’s requirements for delivery, storage and protection of extra materials.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications:

   1. Provider of advanced installer training.
B. Installer Qualifications:

1. At least five years experience in the installation of fiberglass reinforced plastic panels.
2. Experience on at least five projects of similar size, type and complexity as this Project.
3. Employer of workers for this Project who are competent in techniques required by manufacturer for installation indicated.

C. Surface-Burning Characteristics: Determined by testing identical products according to ASTM E84 by a testing agency acceptable to authorities having jurisdiction.

   1. Flame-Spread Index: [25 (Class A)]
   2. Smoke-Developed Index: [450]

D. Mock-ups:

1. Install at Project site (2) wall and (2) ceiling mock-ups using acceptable products and manufacturer-approved installation methods.
2. Construct mock-ups at locations determined by University, Architect and Contractor.
3. Obtain University and Architect approval and acceptance of finish, color, texture, pattern, trim, fasteners, and quality of installation.
4. Mock-Up Size: Determined on site with University, Architect and Contractor.
5. Maintain mock-up during construction for quality comparison.
6. Remove mock-up when no longer required.
7. Mock-up may be incorporated into final construction upon Architect approval.

1.8 DELIVERY, STORAGE AND HANDLING

A. Delivery: Deliver materials in manufacturer’s original, unopened, undamaged containers with identification labels intact. Package sheets on skids or pallets for shipment to project site.

B. Storage and Handling: Store materials protected from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer. Store panels in a dry indoor location at Project site. Remove any foreign matter from face of panel by using a soft bristle brush, avoiding abrasive action.

1.9 PROJECT CONDITIONS

A. Ambient Conditions:

1. During installation, and within 48 hours prior to installation, maintain ambient temperature and relative humidity within limits required by type of panel adhesive used and recommendation of panel adhesive manufacturer.
2. Contractor to sample walls and ceilings with moisture meter prior to installation of FRP.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace FRP panels that fail within specified warranty period.

1. Failures shall include, but not be limited to substantial defects in material and workmanship, rotting, rusting, corrosion, development of structural surface cracks, or requiring painting or refinishing.
2. Warranty Period: One year from date of Substantial Completion.
3. Limited Warranty Period: Prorated years 2 to 10 from date of purchase.

B. Special Warranty: Installer's standard form in which installer agrees to repair or replace FRP panels that fail due to poor workmanship or faulty installation within the specified warranty period.

1. Warranty Period: 5 years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 FIBERGLASS REINFORCED PLASTIC (FRP) PANELS

A. General: Fiberglass reinforced plastic Gelcoat-finished glass fiber reinforced plastic panels complying with ASTM D5319.

B. Basis of Design Product: Subject to compliance with requirements provide Crane Composites, Inc.; Innovative Finishes DESIGNS Wall Panel [IPSA DESIGNS Class A] Fiberglass Reinforced Plastic (FRP) Panels.

C. Substitution Limitations: All other manufacturers: Submit substitution request in accordance with Section 012500 - "Substitution Procedures"

D. Product Options:

1. Pattern: None
2. Surface Finish: Smooth.
3. Nominal Thickness: 0.075 inch (1.9 mm).
4. Wall Panel Size: 4 feet (1.2 m) by 8 feet (2.4 m)

E. Performance Criteria (Class A Panels):

1. Flexural Strength: 18,000 psi (124 Mpa), ASTM D790.
2. Tensile Strength: 10,000 psi (69 Mpa), ASTM D638.
4. Impact Strength (IZOD): 8 ft-lb/sq in (0.43 J/mm) ASTM D256, showing no visible damage on finish side.
5. Water Absorption: 0.16 percent in 24 hours at 77 deg F (25 deg C), ASTM D570.

F. Panel Compliance: ASTM D 5319.

G. Panel Color: As selected by Architect from manufacturer’s full range.

H. Panel dimensions:

1. Nominal Thickness: [0.09 inch (2.3 mm)].
2. Wall Panel Size: As large as possible to fit wall dimensions.
3. Ceiling Panel Size: As large as possible to fit ceiling dimensions.

2.2 ACCESSORIES

A. Moldings: PVC Pattern-matched to panel
B. Panel Adhesive: As recommended by panel manufacturer for the required substrates.
1. Adhesive shall have a VOC content of [50] g/L or less.
C. Panel Seam Sealant: Bright white, 2-part urethane sealant, as recommended by FRP panel manufacturer.
   1. VOC Content: 0.0 g/L.
D. Rivets:
   1. Color: Match FRP panels.

2.3 SOURCE QUALITY CONTROL

A. Obtain fiberglass reinforced panels, moldings and other accessories from a single manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. General: Comply with manufacturer’s product data, including product technical bulletins, and installation instructions in product catalogs and product packaging.

B. Verify that substrates previously installed under other sections are acceptable for product installation in accordance with FRP manufacturer’s instructions.
   1. Examine substrate surfaces to determine that corners are plumb and straight, that surfaces are smooth, sound and uniform, that nails or screw fasteners are countersunk, and that joints and cracks are filled flush and smooth with adjoining surfaces.
   2. Do not begin panel installation until substrate surfaces are in satisfactory condition.

C. Notify Architect of conditions that would adversely affect installation or subsequent use.

3.2 PREPARATION

A. Clean substrates to remove substances that could impair bond of adhesive, including oil, grease, dirt, dust or other contamination.

B. Condition panels by unpacking and placing in installation space no less than 24 hours before installation.

C. Lay out paneling before beginning installation. Locate panel joints to provide equal panel widths at ends of walls and so that trimmed panels at corners are not less than 12 inches (300 mm) wide.

3.3 INSTALLATION

A. General: Comply with panel manufacturer’s Installation Guide #6876.
B. Install FRP panels in accordance with manufacturer’s instructions at locations indicated on the Drawings.
C. Install FRP panels plumb, level, square, flat, and in proper alignment.
D. Install FRP panels to be water resistant and washable.
E. Cut and drill panels, finished face down, with carbide tipped saw blades or drill bits, or cut with snips.
F. Install panels with manufacturer’s recommended gap for panel field and corner joints.
   1. Pre-drill fastener holes in panels, 1/8 inch (3.2 mm) greater in diameter than fastener.
   2. Install panels in a full spread of adhesive. For trowel type and application of adhesive, follow adhesive manufacturer’s recommendations.
   3. Maintain uniform space between panels and wall fixtures. Fill space between panels with sealant: fill space between panels and wall fixtures, door frames, or any dis-similar material with sealant.
   4. Maintain uniform space between adjacent panels and between panels and floor, base, ceilings and fixtures. Fill space with sealant.
   5. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.

G. Fasteners:
   1. Use fasteners in accordance with manufacturer’s instructions to install FRP panels securely to supports.
   2. Pre-drill fastener holes in FRP panels, 1/8 inch (3.2 mm) greater in diameter than fasteners.

H. Adhesive:
   1. Install FRP panels in full spread of adhesive.
   2. Follow adhesive manufacturer’s instructions for application of adhesive.

J. Install trim accessories with adhesive and nails or staples. Do not fasten through panels.

K. Sealant:
   1. Fill grooves in trim accessories with sealant before installing panels and bed inside corner trim in a bead of sealant.
   2. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths.

L. Tolerances: Install FRP panels within manufacturer’s installation tolerances.

3.4 FIELD QUALITY CONTROL

A. Manufacturer’s Field Services: If requested by Owner, provide manufacturer’s field service consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer’s instructions.

   1. Site Visits: As requested by Owner

3.5 ADJUSTING

A. Repair minor damages to finish in accordance with manufacturer’s instructions and as approved by Architect.

B. Remove and replace with new material, damaged components that cannot be successfully repaired, as determined by Architect.

3.5 CLEANING

A. Remove temporary coverings and protection of adjacent work areas.
B. Repair or replace any installed products that have been damaged.

C. Clean installed panels promptly after installation in accordance with manufacturer’s instructions prior to Owner’s acceptance. Do not use harsh cleaning materials or methods that could damage the finish.

D. Remove and lawfully dispose of construction debris from project site.

3.6 PROTECTION

A. Protect installed product and finish surfaces from damage during construction.

END OF SECTION
SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 SYSTEM REQUIREMENTS

A. Design Requirements:

1. Single-source Responsibility: Provide primers and undercoats produced by and certified compatible with each other and with topcoat.

2. Quality: Provide manufacturer’s first line commercial products.

3. Locally available: Provide products readily available within the Denver metro area in 1 and 5 gallon containers. Readily available means within 24 hours of placing order.

4. Dry Film Thickness (DFT): Apply all coatings in strict conformance with manufacturer’s recommendations for minimum DFT.

1.2 SUBMITTALS

A. MSDS: Contractor to provide Material Safety Data Sheets (MSDS) for all coatings to the University Project Manager prior to application.

1. Product Data
2. Samples.

B. Extra Materials: Deliver to Owner 1 gal. of each color and type of finish-coat paint used on Project, in containers, properly labeled and sealed.

1.3 QUALITY ASSURANCE

A. MPI Standards: Provide products that comply with Master Painter Institute (MPI) standards indicated and that are listed in it’s “MPI Approved Products List”

B. All painting must be of journeyman level craftsmanship, paying special attention to preparation, etching, priming and undercoating.

PART 2 - PRODUCTS

2.1 PRIMERS/SEALERS

A. Primer Sealer, Interior, Institutional Low Odor/No VOC, for Gypsum Board and plaster substrates: MPI #149

2.2 METAL PRIMERS
A. Primer, Rust-inhibitive, water based, for ferrous metal substrates: MPI #107

2.3 WATER BASED PAINTS

A. Latex, Interior Gloss (Gloss Level 6, except minimum gloss of 65 units at 60 degrees): MPI #114
B. Latex, Interior, Institutional Low-Odor/No VOC, Flat (Gloss Level 1): MPI #143
C. Latex, Interior, Institutional Low-Odor/No VOC, Egg shell (Gloss Level 2) MPI #144 or (Gloss Level 3) MPI #145

PART 3 - EXECUTION

3.1 PREPARATION

A. Comply with recommendations in MPI's "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
B. Remove hardware, lighting fixtures, and similar items that are not to be painted. Mask items that cannot be removed. Reinstall items in each area after painting is complete.
C. Clean and prepare surfaces in an area before beginning painting in that area. Schedule painting so cleaning operations will not damage newly painted surfaces.

3.2 APPLICATION

A. Comply with recommendations in MPI's "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
B. Paint exposed surfaces, new and existing, unless otherwise indicated.
   1. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces.
   2. Paint surfaces behind permanently fixed equipment or furniture with prime coat only.
   3. Paint the back side of access panels.
   5. Do not paint prefinished items, items with an integral finish, operating parts, and labels unless otherwise indicated.
C. Apply paints according to manufacturer's written instructions.
   1. Use brushes only where the use of other applicators is not practical.
   2. Use rollers for finish coat on interior walls and ceilings.
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.
   1. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

END OF SECTION 099123
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1.1 RELATED DOCUMENTS:

A. All drawings associated with the entire project, including general provisions of the contract, including the general conditions of the contract for construction, general and supplementary conditions and division 1 conditions specification sections shall apply to the division 23 specifications and drawings. The contractor shall be responsible for reviewing and becoming familiar with the aforementioned and all other contract documents associated with the project.

B. Where contradictions occur between this section and division 1 of the base contract with the owner, the more stringent requirement shall apply.

C. Contractor shall be defined as any and all entities involved with the construction of the project.

1.2 SUMMARY:

A. This section specifies the basic requirements for mechanical installations and includes requirements common to more than one section of division 15. It expands and supplements the requirements specified in division 1 of the base contract with the owner.

1.3 MECHANICAL INSTALLATIONS

A. The contract documents are diagrammatic, showing certain physical relationships which must be established within the mechanical work and its interface with all other work. Such establishment is the exclusive responsibility of the contractor. Drawings shall not be scaled for the purpose of establishing material quantities.

B. Drawings and specifications are complementary. Whatever is called for in either is binding as though called for in both. Report any discrepancies to the engineer and obtain written instructions before proceeding. Where any contradictions occur between the specifications and the drawings the more stringent requirement shall apply. The contractor shall include pricing for the more stringent and expensive requirements.

C. The exact location for some items in this specification may not be shown on the drawings. The location of such items may be established by the engineer during the progress of the work.

D. The contract documents indicate required size and points of terminations of pipes, and suggest proper routes to conform to structure avoid obstructions and preserve clearances. It is not intended that drawings indicate necessary offsets. The contractor shall make the installation in such a manner as to conform to the structure, avoid obstructions, preserve headroom and keep openings and passageways clear, without
further instructions or costs to the owner. All equipment shall be installed so access is maintained for serviceability.

E. Before any work is installed, determine that equipment will properly fit the space and that required piping grades can be maintained without interferences between systems, structural elements or work of other trades.

F. Verify all dimensions by field measurements.

G. Coordinate installation in chases, slots and openings with all other building components to allow for proper mechanical installations.

H. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the work.

I. Where mounting heights are not detailed or dimensioned, install mechanical services and overhead equipment to provide the maximum headroom possible.

J. Install mechanical equipment to facilitate maintenance and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.

K. The contractor shall provide all labor and material necessary but not limited to the starting/stopping of all mechanical equipment, opening/closing of all valves, draining/refilling all mechanical systems and operating/verifying the operation of all mechanical systems controls as required to accomplish all work necessary to meet construction document requirements. Contractor shall submit records of such activities to engineer and include in the o & m manuals.

1.4 COORDINATION

A. Work out all installation conditions in advance of installation. The contractor shall be responsible for providing all labor and material, including but not limited to all fittings, isolation valves, offsets, hangers, control devices, etc., necessary to overcome congested conditions at no increase in contract sum. The contractor’s base bid shall include any and all time and manpower necessary to develop such coordination efforts. Increases to contract sum or schedule shall not be considered for such effort.

B. Provide proper documentation of equipment, product data and shop drawings to all entities involved in the project. Coordination shall include, but not be limited to the following:

1. Automatic temperature controls, building management and testing, adjusting and balancing contractors shall be provided with equipment product data and shop drawings from other contractors and shall furnish the same information involving control devices to the appropriate contractor.

C. Cadd drawings: electronic mechanical AutoCAD drawings are available for purchase by the contractor from the engineer. Contact engineer for further information in
acquiring cadd drawings. The engineers construction documents cannot be used directly for coordination drawings. They are for information and initial coordination only.

1.5 COORDINATION WITH OTHER DIVISIONS:

A. General

1. Coordinate all work to conform with the progress of the work of other trades.
2. Complete the entire installation as soon as the condition of the building will permit. No extras will be allowed for corrections of ill timed work, when such corrections are required for proper installation of other work.

B. Coordinate the cutting and patching of building components to accommodate the installation of mechanical equipment and materials. Refer to division 1 of the base contract with the owner.

C. Modifications required as result of failure to resolve interferences, provide correct coordination drawings or call attentions to changes required in other work as result of modifications shall be paid for by responsible contractor/subcontractor.

1.6 DESIGN WORK REQUIRED BY CONTRACTOR:

A. The construction of this project requires the contractor to include the detailing and design of several systems and/or subsystems. All such design work associated with the development of the coordination drawings shall be the complete responsibility of the contractor.

B. The contractor shall take the full responsibility to develop and complete routing strategies which will allow fully coordinated system to be installed in a fully functional manner. The engineers contract drawings shall be for system design intent and general configurations.

C. Systems or subsystems which require design responsibility by the contractor include but are not limited to:

1. Final coordinated distribution of duct, hydronic, plumbing and other systems within the ceiling cavity.
2. Any system not fully detailed.
3. Equipment supports, hangers, anchors and seismic systems not fully detailed nor specified in these documents, or catalogued by the manufacturer.

D. Design limitations:

1. The contractor shall not modify the engineers design intent in any way.
2. The contractor shall not change any pipe size or equipment size without prior written approval from the engineer.
3. Bull nosed tees on piping systems shall not be installed under any circumstance.
1.7 PROJECT CONDITIONS:

A. The contractor shall be required to attend a mandatory pre-bid walk-thru and shall make themselves familiar with the existing conditions. No additional costs to the owner shall be accepted for additional work for existing conditions.

B. Field verify all conditions prior to submitting bids.

C. Report any damaged equipment or systems to the owner prior to any work.

D. Protect all mechanical and electrical work against theft, injury or damage from all causes until it has been tested and accepted.

E. Be responsible for all damage to the property of the owner or to the work of other contractors during the construction and guarantee period. Repair or replace any part of the work which may show defect during one year from the final acceptance of all work, provided such defect is, in the opinion of the architect, due to imperfect material or workmanship and not due to the owner's carelessness or improper use.

F. The contractor shall coordinate and co-operate with owner at all times for all new to existing connections, system shutdowns and start-ups, flushing and filling both new and existing systems.

G. Provide temporary ductwork and piping services, where required, to maintain existing areas operable.

H. Coordinate all services shut-down with the owner; provide temporary services. Coordinate any required disruptions with owner, one week in advance.

I. Minimize disruptions to operation of mechanical systems in occupied areas.

1.8 SAFETY:

A. Refer to division 1 of the base contract with the owner and conform with the owners requirements.

1.9 EQUAL EMPLOYMENT OPPORTUNITY REQUIREMENTS:

A. Refer to division 1 of the base contract with the owner and conform with the owners requirements.

1.10 REQUIREMENTS OF REGULATORY AGENCIES:

A. Refer to division 1 of the base contract with the owner and conform with the owners requirements.

B. Execute and inspect all work in accordance with all underwriters, local and state codes, rules and regulations applicable to the trade affected as a minimum, but if the plans and/or specifications call for requirements that exceed these rules and
regulations, the greater requirement shall be followed. Follow recommendations of
NFPA, SMACNA, EPA, OSHA and ASHRAE.

C. Comply with standards in effect at the date of these contract documents, except where
a standard or specific date or edition is indicated.

D. The handling, removal and disposal of lead based paint and other lead containing
materials shall comply with EPA, OSHA, and any other federal, state, or local
regulations.

E. After entering into contract, contractor will be held to complete all work necessary to
meet these requirements without additional expense to the owner.

F. Project seismic requirements:

G. All systems shall be installed to meet NFPA and IBC seismic requirements.

1. Where any conflicts arise the more stringent requirements shall be applicable.
2. The design of the seismic requirements shall be the full responsibility of the
contractor.

1.11 TEMPORARY FACILITIES:

A. Light, heat, power, etc.: responsibility for providing temporary electricity, heat and
other facilities shall be as specified in division 1 of the base contract with the owner.

1.12 SUBMITTALS:

A. Submittals shall be made in accordance with section 01300 and as required by various
section of divisions 21, 22, and 23 with the following provisions:

1. Submittals will be reviewed by the engineer to determine that the materials,
equipment, and installation methods are in accordance with the project design
concepts. The contractor shall be responsible for space requirements,
configurations, performance, bases, supports, structural members and openings
in structure, and other apparatus that may be affected by the material,
equipment, or installation.
2. Include current, published catalog and specification sheets pertaining to
proposed material and equipment.
3. Identify each item with identification symbols identical to those used on the
drawings and/or in the specifications.

B. Operation and maintenance manual: furnish operation and maintenance manuals for
equipment and systems installed under divisions 21, 22, and 23 of the standards in
accordance with section 01730 and the following:

1. Submit one copy of the manual to the engineer for preliminary review prior to
production of the final manuals.
2. Following review of the preliminary manual by the engineer prepare and submit final copies of the manual complying with the engineer's comments noted on the preliminary manual.

3. Include the following information:
   a. Alphabetical list of all system components with the name, address, and 24-hour phone number of the company responsible for servicing each item during the first year of operation.
   b. Manufacturer's data that are applicable to the installed equipment such as the following:
      1) Shop drawings (reviewed and net)
      2) Product and performance data (reviewed and net)
      3) Installation instructions
      4) Lubrication instructions
      5) Wiring and temperature control diagrams (reviewed and net drawings)
      6) Parts lists
      7) Copies of warranties
      8) A compilation of the manufacture’s recommended maintenance schedule and routines for each piece of equipment
   c. A simplified description of the operation of each system including, the function of each piece of equipment within the system. Support descriptions with a schematic flow diagram when applicable.
   d. Emergency procedures for equipment operation during a fire or following the failure of major equipment. Describe procedures for normal starting, operating, shutdown, and long-term shutdown.
   e. Maintenance instruction including valves, valve tag, and other identified equipment lists, proper lubricants and lubricating instruction for each piece of equipment, and necessary cleaning, replacing, and adjusting schedules.
   f. Assembly, installation, alignment and adjustment instructions.
   g. System balancing report.
   h. Temperature controls, cut sheets and record drawings.
   i. Commissioning checklists and certification.

C. Record documents: furnish record documents for equipment and systems under divisions 21, 22, and 23 of the standards in accordance with section 01720 and the following:

1. Mark drawing prints to indicate revisions to piping and ductwork, size and location both exterior and interior; including locations of coils, dampers, and other control devices, filters, boxes, and similar units requiring periodic maintenance or repair; actual equipment locations, dimensioned from column lines; actual inverts and locations of underground piping; concealed equipment, dimensioned to column lines; mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located. Note changes of ductwork or piping on the drawings if it has been relocated more than 1 foot from where shown on the drawings.
2. List all equipment parameters on the drawings in schedules whenever possible. Include room number where equipment is located.
3. At the completion of the project, mark all valve tag numbers on the drawings and turn these drawings over to the university project manager.


D. The submittals shall be submitted as one package identified by the specification section. Submittals that are not complete with the required information will be sent back to be corrected.

E. The contractor shall identify any "long lead time" items which may impact the overall project schedule. If these submittal requirements affect the schedule, the contractor shall identify the impacts and confer with the engineer within two weeks of entering into the contract.

F. The design professional’s review and appropriate action on all submittals and shop drawings is only for the limited purpose of checking for conformance with the design concept and the information expressed in the contract documents. This review shall not include:

   1. Accuracy or completeness of details, such as quantities, dimensions, weights or gauges, fabrication processes
   2. Construction means or methods
   3. Coordination of the work with other trades
   4. Construction safety precautions

G. The design professional’s review shall be conducted with reasonable promptness while allowing sufficient time in the design professional’s judgment to permit adequate review. Review of a specific item shall not indicate that the design professional has reviewed the entire assembly of which the item is a component.

H. The design professional shall not be responsible for any deviations from the contract documents not brought specifically to the attention of the design professional in writing by the contractor. This shall clearly identify the design and the specific element which vary from the design. The contractor shall be responsible for all remedy for lack of strict conformance associated with this criteria.

I. The design professional shall not be required to review partial submissions or those for which submissions of correlated items have not been received.

1.13 QUALITY ASSURANCE

A. Installer qualification:

   1. Workmanship shall conform to the highest industry standard for each specific type of work.
   2. Perform work in accordance with standard commercial practices.

B. Comply with part 3 of this manual, state and federal codes, rules and regulations. As a minimum requirement, codes, rules and regulations take precedence over the drawings and specifications. Where the requirements of the drawings and specifications exceed
those of applicable codes, rules and regulations, the drawings and specifications shall govern.

C. Chemical and physical properties, design, and performance characteristics of all material and equipment, and methods of construction shall be in accordance with the following applicable codes, regulations and standards. Current editions in effect 30 days prior to receipt of bids will apply.

   1. Air conditioning and refrigeration institute (ARI)
   2. Air movement and control association, inc. (AMCA)
   3. American gas association (AGA)
   4. American national standards institute (ANSI)
   5. American society of heating, refrigerating and air conditioning engineers (ASHRAE)
   6. American society of mechanical engineers (ASME)
   7. American standard code for pressure piping (ASCPP)
   8. American society for testing and materials (ASTM)
   9. American water works association (AWWA)
  10. Compressed gas association (CGA)
  11. Environmental protection agency (EPA)

1.14 DELIVERY, STORAGE, AND HANDLING:

   A. All mechanical equipment and materials shall be delivered, stored and handled in accordance with manufacturers instructions and the requirements of section 011000 and the following requirements.

   B. Deliver products to project properly identified with names, model numbers, types, grades, compliance labels and similar information needed for distinct identifications; adequately packaged and protected to prevent damage or contamination during shipment, storage, and handling.

   C. Check delivered equipment against contract documents and submittals.

   D. Store equipment and materials at the site, unless off-site storage is authorized in writing. Protect stored equipment and materials from damage, dirt, dust, freezing, heat and moisture.

   E. Coordinate deliveries of mechanical materials and equipment to minimize construction site congestion. Limit each shipment of materials and equipment to the items and quantities needed for the smooth and efficient flow of installations.

   F. Provide factory-applied plastic end-caps on each length of pipe and tube, except for concrete, corrugated metal, hub-and-spigot, clay pipe. Maintain end-caps through shipping, storage and handling to prevent pipe-end damage and prevent entrance of dirt, debris and moisture.

   G. Protect stored pipes and tubes. Elevate above grade and enclose with durable, waterproof wrapping. When stored inside, do not exceed structural capacity of the floor.
H. Protect flanges, fittings and specialties from moisture and dirt by inside storage and enclosure, or be packaging with durable, waterproof wrapping.

1.15 CUTTING AND PATCHING:

A. This article specifies the cutting and patching of mechanical equipment, components and materials to include removal and legal disposal of selected materials, components and equipment.

B. Refer to division 1 of the base contract with the owner.

C. Do not endanger or damage installed work through procedures and processes of cutting and patching.

D. Arrange for repairs required to restore other work, because of damage caused as a result of mechanical installations.

E. No additional compensation will be authorized for cutting and patching work that is necessitated by ill-timed, defective or non-conforming installations.

F. Perform cutting, fitting and patching of mechanical equipment and materials required to:
   1. Uncover work to provide for installation of ill-timed work;
   2. Remove and replace defective work;
   3. Remove and replace work not conforming to requirements of the contract documents;
   4. Remove samples of installed work as specified for testing;
   5. Install equipment and materials in existing structures;
   6. Upon written instructions from the architect/engineer, uncover and restore work to provide for architect/engineer observation of concealed work.

G. Construction and pre-occupancy indoor air quality (IAQ) management:
   1. During construction, meet or exceed the recommended design approaches of the SMACNA 1 AQ guideline for occupied buildings under construction, 1995, chapter 3.

1.16 ROUGH IN:

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

B. Refer to equipment shop drawings and manufacturer's requirements for actual provided equipment for rough-in requirements.

C. Work through all coordination before rough-in begins.

1.17 ACCESSIBILITY:
A. Install equipment and materials to provide required access for servicing and maintenance. Coordinate the final location of concealed equipment and devices requiring access with final location of required access panels and doors. Allow ample space for removal of all parts that require replacement or servicing.

B. Furnish hinged steel access doors with concealed latch, whether shown on drawings or not, in all walls and ceilings for access to all concealed valves, shock absorbers, air vents and other operating devices requiring adjustment or servicing. Refer to division 1 of the base contract with the owner for access door specification and division 15 for duct access door requirements.

C. Furnish doors to trades performing work in which they are to be built, in ample time for building-in as the work progresses. Whenever possible, group valves, cocks, etc., to permit use of minimum number of access doors within a given room or space.

D. Factory manufactured doors shall be of a type compatible with the finish in which they are to be installed. In lieu of these doors, approved shop fabricated access doors with Durodyne hinges may be used.

E. Access doors in fire-rated walls and ceilings shall have equivalent UL label and fire rating.

1.18 WARRANTY:

A. All mechanical equipment, materials and workmanship warranties shall be provided in accordance with the requirements of section 01740 and the following:

1. Warranty all equipment, materials, workmanship, and proper operation of equipment and apparatus for a period of one year from date of final acceptance unless indicated otherwise in the individual sections. Extended warranty periods are identified in individual sections.
2. Compile and assemble the warranties specified in the individual sections into the operating and maintenance manuals.
3. Provide complete warranty information for each item to include date or beginning of warranty or bond; duration of warranty or bond; and names, addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services.

1.19 MATERIALS, GENERAL:

A. Products:

1. Provide material and equipment new and free from defects.
2. Install all material and equipment in accordance with the manufacturer's current published recommendations.
3. Certain materials and equipment are specified by manufacturer and model or catalog number. Such specified items are the basis of design and establish a degree of quality, performance, and physical configuration.
4. Equipment and materials manufactured by any one of the manufacturers listed on the drawings or in the specifications will be acceptable.
5. Where no manufacturer is listed, provide a standard product meeting the requirements of the drawings and specifications, and manufactured by a firm regularly engaged in the manufacture of such products. All equipment, when possible, shall be:
   a. Manufactured and purchased in Colorado
   b. Manufactured and purchased in the USA.
6. Requests prior to bid for approval of equipment or material not specified shall be done in accordance with the requirements of section 012500.

1.20 EXECUTION:

A. Additional charges will not be authorized due to the contractor's failure to become familiar with the existing conditions.

1.21 INSTALLATION, GENERAL

A. Permits and inspections:
   1. Secure all required permits, the university will pay for permit and inspection costs.
   2. Pay all applicable royalties, inspection fees, taxes, and licenses.

B. Permits and inspections:
   1. The contractor is responsible for the complete installation and satisfactory operation of all work in accordance with requirements of the drawings and specifications.
   2. The component parts of the installation shall function together as workable systems. Each system shall be left with all parts adjusted and in proper working order.

C. Coordination:
   1. Coordinate project in accordance with section 01040.

D. Scaffolding, rigging, and hoisting:
   1. Provide all scaffolding, rigging, and hoisting necessary to safely accomplish the work following OSHA requirements. Remove from premises when no longer needed.
   2. Provide necessary services to deliver, erect, place, and install all equipment and apparatus furnished.

E. Damaged surfaces:
   1. At completion of the work, all mechanical material and equipment furnished shall be inspected for damage.
   2. Repair damaged factory finishes to match adjacent, undamaged areas.
1.22 TESTING, CLEANING AND CERTIFICATION:

A. Cleanup:

1. At completion of the work, check and thoroughly clean all equipment.
   a. Clean coils and plenums.
   b. Clean under, in, and around equipment.
   c. Clean exposed surfaces of piping, ducts, and hangers.
   d. Clean equipment cabinets and enclosures.
   e. Provide and install new filters for equipment.

B. Project closeout:

   a. Verify that all work has been completed prior to requesting final walkthrough, including contractor’s preliminary review of mechanical systems start-up and acceptance checklists.

C. Commissioning (demonstration)

1. Training and demonstration: schedule instructional meetings for the university’s facilities operations maintenance personnel on the proper operation and maintenance of mechanical systems. Provide the project manager a minimum of 5 days notice prior to any training, demonstration, or testing.

END OF SECTION
SECTION 23 05 53 - IDENTIFICATION FOR PIPING AND EQUIPMENT

1.1 MANUFACTURERS:

A. Acceptable manufacturers: subject to compliance with requirements, provide products by the following:

1. Identification devices:
   a. Seton name plate company
   b. Marking services, inc.
   c. National marker co.

2. Paint:
   a. Benjamin moore
   b. Devoe
   c. Glidden

1.2 MATERIALS, GENERAL:

A. Plastic pipe markers: pipe labels that adhere to pipe or insulation surface with directional arrows.

B. Tags: engraved anodized aluminum or engraved plastic, 2-inch diameter. Pre-punched and provided with brass chain.

C. Labels and nameplates: laminated three-layer plastic with black engraved letters on light contrasting background color,

D. Drilled for mounting with two sheet metal or brass screws. Pressure-sensitive embossed labels are not acceptable.

E. Paint stencils: use metal stencils only. No cardboard stencils are allowed. Size of legend and letters for stencils:

1. For insulation pipe diameters from 3/4” to 1-1/4”: utilize an 8” long color field with 1/2” tall letters.
2. For insulation pipe diameters from 1-1/2” to 2”: utilize an 8” long color field with 3/4” tall letters.
3. For insulation pipe diameters from 2-1/2” to 6”: utilize a 12” long color field with 1-1/4” tall letters.
4. For equipment: utilize 2-1/2” tall letters.


1.3 INSTALLATION, GENERAL:
A. Provide pipe identification, valve tags, stencils, or engraved name plates to clearly identify all mechanical equipment, including motors, piping and controls of the various mechanical systems and direction of flow in piping.

B. Plastic pipe markers: on bare pipe when surface temperature exceeds 180 degree f provide a 1-inch thick insulation band under marker for protection from the hot pipe.

C. Piping, ducts, and equipment identification:

1. Piping: identify all piping accessible for maintenance in crawl spaces, tunnels, above ceilings, and access spaces as well as exposed to view utilizing stenciled markings according to the following procedures:
   a. Use an arrow marker for each pipe-content legend. The arrow shall always point away from the pipe legend and in the direction of flow. Color and height of arrow to be same as content legend lettering.
   b. If flow can be in both directions, use a double-headed arrow indication.
   c. Apply pipe legend and arrow indication at every point of pipe entry or exit where line goes through wall or ceiling cut.
   d. Apply pipe legend and arrow indication within 3 inch of each valve to show proper identification of pipe contents and direction of flow.
   e. Apply legend to the pipe so that lettering is in the most legible position. For overhead piping, apply legend on the lower ha manual operating switches, fused disconnect switches and thermal over-load switches which have not been specified as furnished with indexed face plates: install nameplates or be stencil as to controlled equipment.
   g. Legend on steam piping, condensate return, compressed air, gas, and vacuum systems: include working pressure or vacuum.

2. Valves:
   a. System service valves located inside the building: tag and identify as to type of service.
   b. Valves or cocks controlling branch mains or risers to various portions of the building: tag and identified as to service and location.

3. Controls:
   a. Magnetic starters and relays: install nameplates or stencil to identify connecting or controlled equipment.
   b. Manual operating switches, fused disconnect switches and thermal over-load switches which have not been specified as furnished with indexed face plates: install nameplates or be stencil as to controlled equipment.
   c. Automatic controls, control panels, zone valves, pressure electric, electric pressure switches, relays, and starters: clearly identified with unit served and function.
   d. Identify all starters, disconnect switches, and manually operated controls, except integral equipment switches with nomenclature corresponding to
operating instructions in the "operation and maintenance manual". Coordinate with the university facilities operations personnel through the university project manager.

4. Air conditioning equipment:
   a. Equipment such as chillers, pumps, condensers, or rooftop equipment: identified by stencils, or system nameplates. Labels of remote equipment shall also indicate the space(s) being served and the location of their electrical breaker (panel id, room no. And circuit).
   b. Identify locations of air handling devices which have filters and are above accessible ceilings by a blue circular dot or tack at least 3/4 inch in diameter, or embossed tape, adhered to the nearest t-bar.

5. Access doors:
   a. Provide engraved nameplates or painted stencils to identify concealed valves, controls, dampers or other similar concealed mechanical equipment.
   b. Identify the locations of fire dampers above accessible ceilings with a red circular dot at least 3/4 inch in diameter, or embossed tape, adhered to the nearest t-bar. Access door shall be painted red.
   c. Obtain the university project manager’s approval before installation on all access doors in finished areas.

6. Lift-out ceilings:
   a. Provide engraved nameplates on ceiling tee stem (screwed or riveted, adhesive not allowed) to identify concealed valves, filters, fire/smoke dampers or similar concealed mechanical equipment that is directly above nameplate in ceiling space.
   b. Obtain the university project manager’s approval before installation.

7. Terminal units:
   a. Identify all units with unique numbers corresponding to the drawings, and indicate the space being served.
   b. Use engraved plastic laminate labels affixed to each box by screws or rivets.

1.4 PIPING IDENTIFICATION COLORS AND LEGEND

A. This project is a renovation to an existing building. Adhere to the existing letter and field colors and legend. Provide submittal of these existing criteria within two weeks of start of project for review by engineer and ucd project manager.

END OF SECTION
SECTION 23 05 93 – TESTING AND BALANCING

1.1 GENERAL:

A. General, mechanical and electrical contractors are required to coordinate and cooperate with the tab contractors as necessary to allow them to perform work.

B. Items such as start-up, initial testing, cleaning, calibration of controls, electrical testing, etc., are to be completed prior to the commencement of tab work.

C. Submit name of balancing and testing agency with resume of the agency, including qualifications of personnel to be used and authority and responsibilities of personnel.

D. Product data shall be submitted, in accordance with section 23 00 00, for each of the following:

1. Procedure submittal: prior to commencing work, submit, for approval, a written procedure of how balance will be performed and a description and manufacturer’s name of equipment and instruments to be used. The submittal shall include, but not necessarily be limited to the following:

   a. List of preliminary checks to be performed at the job site such as confirmation that manual volume dampers are present, filters are installed, frequency drive units operational, location of control sensors, etc.
   b. Identify how the air outlets will be measured and the type of instruments to be used.
   c. Locations of pilot traverses and the type of instruments to be used.
   d. Modes of operation that the system will be placed in during balancing and testing, i.e., full cooling and heating, maximum and minimum outside air flows, maximum and minimum sash positions for fume hoods, toilet fans on or off, etc.
   e. Position of doors and windows during balance, i.e., some labs should be balanced with doors shut.
   f. Operating static pressures for terminal devices and pressure sensors for controlled devices.
   g. Initial test procedures for preliminary balance.
   h. Final test procedures.
   i. List of deficiencies in mechanical system that could hinder the balance work such as missing or leaky dampers, incomplete systems, inadequate fans, etc.
   j. Sample of data sheets and test forms to be used in final report.
   k. Identification and manufacturer’s name of equipment to be used on project and proof of last calibration on each piece.

2. Progress report(s) – report, in writing, any deficiencies or problems with air or water systems that have affected balance work. Include items that affect system
performance such as broken thermostats, damaged ductwork, excessive noise, etc.

1.2 QUALITY ASSURANCE

A. Test, adjust, and balance systems in accordance with ASHRAE applications handbook. For NEBB certification, comply with “procedural standards for testing, adjusting, and balancing of environmental systems.” For AABC certification, comply with “national standards for testing and balancing heating, ventilating, and air conditioning systems.”

B. Tab contractors shall present to the university project manager and general contractor, proof of current equipment certification approved by national institute of standards and technology.

C. Testing agency qualifications: agency shall be NEBB or AABC certified in testing and balancing disciplines required for this project. Work shall be performed under direct supervision of professional engineer, NEBB, or AABC certified supervisor.

D. Guarantee of work: tab contractor shall guarantee the balancing for a period of 90 days from date of acceptance of final report. During this period, the tab contractor shall make personnel available at no cost to the university to verify measurements and/or correct deficiencies in the balance. During this period, emergency adjustments shall not void this Warranty.

1.3 INSTALLATION, GENERAL

A. Pre-balancing conference: before beginning testing, adjusting, and balancing procedures, schedule and conduct a conference with university project manager, facilities operations representative(s) and representatives of installers of mechanical and control systems. Conference objective is final coordination and verification of system operation and readiness for testing, adjusting, and balancing, and assigning testing responsibilities of each installer.

B. Systems shall be complete and fully operational prior to beginning procedures. Insure all items such as thermometer wells, pressure test-cocks, access doors, etc., are installed to facilitate tests and adjustments.

C. Put all heating, ventilating, and air conditioning systems and equipment into full operation and continue operation during testing and balancing.

D. Before air balance work is started, check system for duct leakage, install a complete set of clean filters, check for correct fan rotation and equipment vibration, and check automatic dampers for proper operation. Set volume control dampers and outlets in wide open position. Ensure fire dampers are open and that return air paths are not obstructed.
E. Prior to performing hydronic balance work; check system for plugged strainers, proper pump rotation, and proper control valve installation and operation. Check air vents at high points of systems to ensure all are installed and operating freely (automatic type) or bleed air completely (manual type); and verify proper flow meter and check valve installation and proper system pressure.

F. All throttling devices and control valves shall be set open.

G. Performing testing, adjusting, and balancing:
   1. Cut insulation, ductwork, and piping for installation of test probes to minimum extent necessary to allow adequate performance of procedures.
   2. Patch insulation, ductwork, and housings, using materials identical to those removed.
   3. Reseal ducts and piping, and test for and repair leaks.
   4. Reseal insulation to re-establish integrity of the vapor barrier.
   5. Mark equipment settings, including damper control positions, valve indicators, fan speed control levers, and similar controls and devices, to show final settings. Mark with paint or other permanent identification materials.
   6. Retest, adjust, and balance systems subsequent to significant system modifications, and resubmit test results.

H. SEQUENCING AND SCHEDULING:
   1. Systems shall be fully operational before beginning procedures.
   2. Conduct tests in the presence of the university project manager after providing 7-day notice before any test is to be conducted. Provide water and electricity required for tests. Determine that all dampers, registers, and valves are in a set or full open position.

1.4 BALANCING:

A. Water Balance:

   1. Balance water piping systems to produce water quantities within 5 percent of design flow rates for cooling water systems and within 10 percent of design flow rates for heating water systems.
   2. Hydronic systems shall be proportionally balanced, ensuring the path to one terminal is fully open. Total system flow shall be adjusted at pump by restricting discharge balancing valve.
   3. Indicate and record final position of balancing valves.
   4. Primary-Secondary Flow Systems: Balance primary system crossover flow first, then balance secondary system.
   5. Pumps:
      a. Verify pump impeller size and pump rotation.
      b. Measure flow.
      c. Measure inlet and outlet pressures.
      d. Measure motor full load amperage at design flow and shut-off condition.

B. Chillers:
1. Balance water flow through each evaporator and condenser with all pumps operating. With only one chiller operating in a multiple chiller installation, do not exceed flow for maximum tube velocity recommended by chiller manufacturer. Perform tests and record data with each chiller operating at design conditions for:

2. Evaporator and condenser water entering and exiting temperatures, pressure drop, and water flow.
3. Evaporator and condenser refrigerant temperature and pressures.
4. Calculate capacity in tons.
5. For air cooled chillers, verify condenser fan rotation and record fan data, including number of fans and entering and exiting air temperatures.

C. Heat Transfer:

1. Measure entering and exiting water temperatures and pressures.
2. Measure gas flow rate.
3. Measure water flow.
4. Calculate capacity in btu-h.

D. Water Coils: Measure entering and exiting water temperatures and pressures.

1. Measure water flow rate.
2. Measure entering and exiting dry, and wet, bulb air temperatures.
3. Measure airflow. Measure air pressure drop. Calculate capacity in btu-h.

E. Air balance:

1. Balance duct system to produce air quantities within 10 percent of indicated value.
2. Dampers: adjust automatic damper linkages to provide air flow quantities shown. Check all automatic dampers in normal operation to verify proper operation. Verify return, relief air, and fresh air intake dampers operate as designed to produce desired room comfort.
3. Balance terminal outlets in each control zone in proportion to each other. Use branch dampers for major adjusting and terminal dampers for trim or minor adjustment only.
4. Balance VAV fans by placing a certain number of the VAV boxes in full cooling mode. This number shall be equal to the system diversity and shall include boxes that are at the end of the system, that are on duct branches with high static loss and serve critical areas. With the system in this mode the fan shall be sheaved to maintain the static
5. Final adjustments shall include, but not be limited to the following: pressure required to control the worst case VAV box.
   a. For variable air volume (VAV), constant volume boxes, or dual duct boxes, set regulators to provide design minimum and maximum airflow rates. Adjust thermostat to assure proper damper operation.
   b. For VAV, or constant volume boxes with reheat, set regulators to provide design minimum and maximum air flow rates. Check control sequence operation to assure proper sequencing.
c. Air flow performance of boxes for both primary and secondary balance settings shall be verified by flow measuring hood measurements at diffuser outlets.

6. Adjust spaces with pressure gradients or directional air flow requirements to meet standards as well as designated air flows below. Verification of performance shall be made with pressure gradient measurements, smoke tests in presence of the university facilities operations representative, or hot wire anemometer across door cracks etc. Pressure differential measurements are preferred unless gradient is too small (under 0.01 inches w.c.) by standard.
   a. Procedure room pressure gradients shall be at minimum 0.01” from the corridor/linear equipment room to the procedure room in all operating modes.

F. Building automation system: coordinate with section 23 09 00. Inspect temperature control systems for proper sequence of operation and approximate calibration. Report any deficiencies. Include written certificate in balance report that temperature controls function properly.

1. Verify proper operation of devices. Verify that all controllers are calibrated and operational.
2. Check location of transmitters and controllers. Note adverse conditions that would affect control and suggest relocation as necessary to university project manager.
3. Note settings on controllers. Note discrepancies between set point for controller and actual measured variable.
4. Verify operation of all limiting controllers, positioners, and relays (e.g., high and low temperature thermostats, high and low differential pressure switches, etc.).
5. Activate controlled devices, checking for free travel and proper operation of stroke for dampers and valves. Verify and note normally open (NO) or normally closed (NC) operation.
6. Verify sequence of operation of controlled devices. Note line pressures and controlled device positions. Correlate to air or water flow measurements. Note speed of response to step change.
7. Confirm interaction of interlock and lockout systems.

G. After deficiencies are corrected, retest the systems until acceptable values are obtained.

H. Permanently mark balancing devices spray paint indicating final position. Grease markers are not permitted.

1.5 REPORT:

A. Report format: standard forms prepared by the referenced standard for each respective item and system to be tested, adjusted, and balanced. Include information indicated on standard report forms prepared by AABC or NEBB for each respective item and system, and schematic diagrams for each system or piece of equipment to accompany each respective report form. Bind report forms complete with schematic systems diagrams and other data in reinforced vinyl three-ring binders. Provide binding edge
labels with project identification and a title descriptive of contents. Divide contents of binder into following divisions, separated by divider tabs:

1. General information and summary
2. Air systems
3. Temperature control systems
4. Special systems such as fume hood exhaust systems.
5. Sound and vibration systems
6. Recommendations

B. Report contents: provide following minimum information, forms, and data:

1. General information and summary:
   a. Inside cover sheet to identify testing, adjusting, and balancing agency, contractor, and project name. Include contact names, addresses, and telephone numbers.
   b. Certification sheet containing seal, address, telephone number, and signature of certified test and balance engineer.
   c. Listing of instrumentation used for procedures along with proof of calibration.

2. Test data: report shall include the following data, in addition to certified field report readings taken during the balancing and testing operations. Include required or specified reading, first reading taken, and final balanced reading.
   a. Air balance for supply, return, relief, and exhaust systems:
      1) Outlets, inlets, diffusers, registers, and grilles: size, reading orifice size, velocity in fpm, and design and final balanced air quantity in cfm.
      2) Terminal boxes: design and final minimum and maximum cfm settings including fan cfm on fan powered terminal boxes.
      3) Ducts: size, velocity in fpm, and air quantity in cfm.
   b. Water coil size and manufacturer.
      1) Chiller and motor nameplate information.
      2) Pump and motor nameplate information. Include manufacturer's pump curves.
      3) Heat exchanger nameplate information.
   c. Record thermal protection for all motors. Starter brand, model, enclosure type, installed thermal heaters and rating of heaters, required thermal heaters and rating of heaters if different from installed shall be recorded.
   d. Include sheet that reports method of balance, project altitude, and any correction factors used in calculations.
   e. Include a reduced set of contract drawings with all terminals (vav boxes, outlets, inlets, coils, unit heaters, fans, etc.) Clearly marked and all equipment designated.
   f. Prepare list of recommendations for correcting unsatisfactory mechanical performances when system cannot be successfully balanced.

1.6 TESTING, CLEANING AND CERTIFICATION
A. After cleaning, pressure tests, adjusting, and balancing are complete, each system shall be performance tested as a whole to verify that all items perform as integral parts of system, and temperatures and conditions are evenly controlled throughout building. Make corrections and adjustments as required to produce conditions indicated.

B. Provide four (4) copies of testing, adjusting, and balancing report bearing seal and signature of the tab engineer. The report shall be certification that systems have been tested, adjusted, and balanced in accordance with referenced standards; accurate representation of how systems have been installed; and accurate record of all final quantities measured.

C. Final report:

1. Submit a preliminary report within 30 days of completed tab work. Report shall include the following information.
   a. A general discussion preface section. This section shall summarize all abnormalities or problems encountered during the project and what course of action was taken. This summary should be assembled from the written progress reports described earlier, except that it will be expanded to include responses from the engineer, the university project manager and contractor regarding each problem indicated in the progress reports.
   b. Copies of correspondence if related to the performance and balance of the systems.
   c. Status of doors, windows and equipment static pressures during balance work.
   d. Reduced 11" x 17", readable, as-built drawings obtained from the university project manager. All devices and equipment shall be clearly labeled.
   e. Belt and sheave information, fan and motor nameplates information, full load operating voltage and amperage indicate sheave diameter as pitch diameter.
   f. Design and final actual cfm at each system terminal unit. Include terminal/size, inlet static pressure, temperature and velocities read to attain the design CFM.
   g. Overload protection for all motors shall be recorded. Starter and brand model, enclosure type, installed overload devices, original ratings, and set points (and revised device ratings and set points when application) shall be recorded.

2. Any corrective action shall be completed and the systems re-tested. The corrected system information shall be provided in the final report.

3. Final report shall be completed within 30 days of preliminary report.

1.7 TESTING, CLEANING AND CERTIFICATION

A. Upon request of the university facilities operations representative, through the university project manager, the balancing firm shall demonstrate measured quantities of randomly selected equipment. The number of readings verified will not exceed 10 percent of the total in the report.
END OF SECTION
SECTION 23 07 00 – INSULATION

1.1 MANUFACTURERS:

A. Acceptable manufacturers: subject to compliance with requirements, provide products by the following:

1. Insulation: identification and/or type of material from a manufacturer is as shown under each heading of 2.2 materials, general.
   a. Manville products
   b. Certainteed
   c. Rubatex
   d. Knauf
   e. Pittsburgh corning

2. Adhesives, coatings, and sealants:
   a. Foster
   b. Childers product company
   c. Hardcast

1.2 MATERIALS, GENERAL

A. Pipe insulation:

1. Glass fiber: MANVILLE MICRO LOK AP T plus

2. Hydrous calcium silicate
   a. Rigid, molded block, conforming to ASTM C533.
   b. Asbestos-free, color-coded throughout material. Coding shall remain stable throughout rated temperature range.
   c. Thermal conductivity (K value): 0.40 at 300 degrees F.
   d. Maximum service temperature: 1,200 degrees F.
   e. Compressive strength: minimum of 160 PSI to produce 5% compression at 1-1/2 inch thickness.
   f. Tie wires: 16 gauge stainless steel.
   g. Manville Thermo 12/gold

3. Elastomeric foam:
a. Flexible, cellular, molded or sheet; conforming to ASTM C534
b. Thermal conductivity (K value): 0.27 at 75 degrees F
c. Maximum service temperature: 220 degrees F
d. BBX, K-FLEX acceptable for high temp applications to 300 deg F.
e. Connection adhesive: waterproof, vapor retarding, Rubatex R-373
f. UV protective coating: water-based latex enamel paint. Rubatex 374
g. Insulation tape: elastomeric thermal insulation tape with closed-cell structure.
h. Rubatex R-180-FS/R-1800-FS

4. Cellular glass:
   a. Waterproof, closed cell, rigid insulating material composed of sealed glass cells conforming TO ASTM C552.
   b. thermal conductivity (K value): 0.35 at 75 degrees F.
   c. Density: 8 pounds per cubic foot.
   d. Water-vapor permeability: 0.005 perm-inch.
   e. Pittsburgh Corning foamglass.

B. Field applied pipe and fitting jacketing:
   2. Aluminum:
      a. 0.016-inch thick sheet with smooth or embossed finish, longitudinal slip-joints with 2-inch laps.
      b. Sealant: weatherproof.
      c. Fitting covers: die shaped with factory attached protective liner.
   3. Canvas:
      a. Plain weave cotton treated with fire-retardant lagging adhesive.
b. Weight: 6 ounces per square yard.

c. UL listed fabric.

4. Stainless steel: 0.010-inch thick, type 304 stainless steel with smooth or corrugated finish.

C. Duct insulation:

1. Flexible fiberglass blanket:
   a. ASTM C553, type 1, class B-3.
   b. Thermal conductivity (K VALUE): 0.25 at 75 degrees F.
   c. Density: 1.0 pounds per cubic foot.
   d. Vapor Barrier Jacket: Aluminum foil reinforced with fiber-glass yarn and laminated to fire-resistant kraft (foil scrim kraft)
   e. Manville Microlite.

2. RIGID FIBERGLASS BOARD: NOT ALLOWED.

3. Interior duct lining allowed only for sound attenuation at ventilation system terminal units. Insulation shall be installed only on the leaving side of the terminal box, and in quantities of less than six lineal feet. Duct liner is not allowed in lab air supply.

D. Duct jacketing:

1. Canvas:
   a. Plain weave cotton treated with fire-retardant lagging adhesive.
   b. Weight: 6 ounces per square yard.
   c. UL Listed Fabric.

E. Duct liner:

1. DUCT LINER IS NOT ALLOWED IN THIS SUPPLY DUCT FOR THIS PROJECT.

F. Equipment Insulation:

1. Flexible Fiberglass Blanket:
   a. ASTM C612, Class 1.
   b. Thermal Conductivity (k value): 0.24 at 75 degrees F.
c. Maximum Service Temperature: 450 degrees F.
d. Density: 1.5 pounds per cubic foot.
e. Vapor Retarder Jacket: Aluminum foil reinforced with fiber glass yarn and laminated to fire-resistant kraft paper.
f. Manville 812 Spin-Glass.

2. Rigid Fiberglass Board:
   a. ASTM C612, Class 1 or Class 2.
   b. Thermal Conductivity (k value): 0.23 at 75 degrees F.
   c. Maximum Service Temperature: 450 degrees F.
   d. Density: 3 pounds per cubic foot.
   e. Vapor Retarder jacket: Aluminum foil reinforced with fiberglass yarn and laminated to fire-resistant kraft paper.
   f. Facing: 1-inch galvanized hexagonal wire mesh stitched on one face of insulation.
   g. Manville 814 Spin-Glas.

1.3 INSTALLATION, GENERAL:

A. Overview:

1. Install insulation of thickness to meet or exceed the requirements of 2015 IECC.

2. Install insulation only after piping, ducts, and equipment have been tested and approved by the project manager, and after all other tests and certifications which are required by the specifications have been satisfactorily completed.

3. Continue insulation vapor barriers through penetrations except where prohibited by code.

4. Install pipe and duct insulation continuous through wall and floor openings except where the penetrated surfaces or assemblies are fire-resistance rated. Provide fire-stop insulation at penetrations of fire-rated surfaces and assemblies. Maintain fire-resistance ratings of penetrated surfaces and assemblies.

5. Install insulation on cold surfaces with a continuous, unbroken vapor seal. Insulate and vapor seal supports and anchors, which are directly secured to cold surfaces.

6. Seal all exposed raw edges of insulation with vapor retarder or finishing cement.

7. Do not use staples on vapor barrier jackets. Where staples must be used, thoroughly seal the vapor barrier penetrations with a white vapor-barrier finish. The engineer prior to installation must approve use of staples.

8. Do not weld insulation support pins to pressure vessels.
9. Leave all insulation surfaces dry and clean, and ready for subsequent work.

B. Installation of piping insulation:
   1. Install insulation and covers with seams in the least visible location.
   2. Neatly finish insulation at supports, protrusions, and interruptions.
   3. Verify piping wells and p & t taps are extended so that they will be flush with the surface of the finished insulation.
   4. Insulated dual-temperature piping systems and for insulated piping conveying fluids of a temperature less than the ambient temperature: install vapor-retardant jacket with self-sealing lap joints. Insulate the complete systems.
   5. Insulated piping conveying fluids of a temperature greater than the ambient temperature: install vapor-retardant jacket with self-sealing lap joints. Bevel and seal ends of insulation at equipment, flanges, and unions.
   6. Piping conveying cold fluids: insulate continuous through hangers. Install rigid insulation inserts at pipe hangers and supports. Butt inserts tight to insulation. Apply a wet coat of vapor-barrier lap cement on butt joints and seal the joints with three-inch wide vapor-barrier tape or band.
   7. Install calcium silicate insert between support shields and piping for piping 1-1/2 inches and larger. Inserts shall not be less than the following lengths:
      a. Pipe size 1-1/2": 6 in. insert length
      b. Pipe size 2" thru 9": 9 in. insert length
   8. Exposed piping in mechanical equipment rooms and exposed piping within 10 feet of the finished floor in finished spaces: install PVC jacket and fitting covers or aluminum jacket.

C. Installation of blanket insulation:
   1. Apply insulation with edges tightly butted. Overlap facing at least two inches at joints. Seal joint in vapor seal with fire-retardant adhesive. Secure insulation to duct with approximately four-inch wide fire-retardant adhesive spaced at 8 inches on center
   2. Ducts exceeding 30 inches in width: install mechanical fasteners at 18 inches on center for the underside insulation in addition to the adhesive. Cut off the protruding ends of the fasteners flush after speed clips are installed and seal with vapor tape or mastic.
   3. Insulated ducts conveying air of a temperature less than the ambient temperature: install vapor retardant jacket. Seal jacket seams and penetrations with UL listed tape or vapor retardant adhesive.
4. Insulated ducts conveying air of a temperature greater than the ambient temperature: bevel and seal ends of insulation where service access is required.

5. Ducts subject to physical abuse in mechanical equipment rooms and finished spaces: install PVC or aluminum jacket.

D. Installation of Equipment Insulation:

1. Apply insulation as close as possible to equipment. Groove, score, and bevel insulation as necessary to achieve a tight fit. Secure insulation to equipment with studs, clips, pins, adhesive, wires, or bands as appropriate for the application. On cold equipment, do not use securing methods that penetrate the vapor barrier.

2. Fill joints, cracks, seams, and depressions with bedding compound. Form smooth surfaces. On cold equipment, use vapor retardant cement.

3. Insulated dual-temperature equipment and for insulated equipment that contains fluids of a temperature less than the ambient temperature: Install vapor retardant jackets.

4. Insulated equipment that contains fluids of a temperature greater than the ambient temperature: Install jacket with or without vapor barrier.

5. Cover insulation with metal mesh and finish with heavy coat of insulating cement, mastic, or aluminum jacket.

6. Do not insulate over nameplates, ASME stamps or UL labels. Bevel and seal insulation around nameplates and labels.

7. When equipment with insulation requires periodic opening for maintenance, repair, or cleaning, install insulation so that it can be easily removed and replaced without damage.

E. Installation of insulation on fittings and valves:

1. Factory pre-molded one piece PVC insulated fitting covers: use factory precut insulation applied to the fitting using two layers for pipe temperatures above 250 degrees F or below 35 degrees F, single layer insulation is acceptable between 35 degrees F and 250 degrees F. Tuck the ends of the insulation snugly into the throat of the fitting and the edges adjacent to the pipe covering, tufted and tucked in, fully insulating the pipe fitting. Covers shall overlap the adjoining pipe insulation and jackets, and on cold pipes seal at all seam edges with vapor barrier adhesive. Seal circumferential edges of all covers with pressure sensitive vinyl tape. The tape shall overlap the jacket and the cover at least one inch.

2. Where PVC covers are prohibited: use as an alternate one of the following methods: aluminum covers, one coat insulation cement, pre-molded fiberglass fitting covers, or mitered segments of pipe insulation. Finish for non-PVC or aluminum shall be glass fabric embedded in fire retardant mastic lapped 2
inches over piping insulation. Finish with second coat of mastic. Mastic shall be vinyl acrylic mastic Childers CP-11 for hot piping and shall be CHILDERS CP-30 or Fosters 30-35 or equal for cold piping.

3. Valves may be insulated with sections of fiberglass pipe insulation complete with all service jacket. Raw ends shall be coated with vinyl acrylic mastic Childers CP-11 for hot piping or shall be coated with vapor barrier mastic Childers CP-30 or Fosters 30-35, or equal for cold piping.

4. Insulate balancing cocks, strainer drains, hose bibs, and equipment requiring periodic maintenance with segmental insulating with an integral vapor barrier. Insulation and vapor barrier shall be easy to remove and replace.

F. Installation of steam and hot water valves insulation:

1. Provide custom fabricated insulated jackets for all valves and fittings.
2. Fabricate inner and outer jacketing for exposure to steam leaks on medium and high-pressure steam systems. Jacketing shall retain full flexibility after an exposure from minus 50 degrees F to plus 500 degrees F.

G. Construct and install covers to shed water. Locate closing seams at the gravitational bottom. Closely contour removable covers, ensure neat appearance and thermal performance. Individual covers or cover segments shall not weigh more than 60 pounds.

END OF SECTION
SECTION 23 09 00 - INSTRUMENTATION AND CONTROLS

1.1 GENERAL

A. Provide control systems consisting of thermostats, control valves, dampers, operators, indicating devices, interface equipment, and other apparatus required to operate mechanical system and to perform functions specified.

B. Provide necessary materials and field work necessary to connect control components factory supplied as part of equipment controlled, unless specified otherwise.

C. Extend existing DDC controls utilizing hardware and software compatible with current system. Provide field control panels, input/output cards, application specific controllers, lan cabling and routers and other components as required to provide a complete system. Perform all programming and modify graphical user interface as required by this work.

1.2 SUBMITTALS

A. Submit Autocad (or Autocad compatible through DXF conversion) generated schematic in hardcopy and electronic media for the entire control system, for review and approval before work shall begin. The hardcopy drawings shall be submitted on 8-1/2” x 11” or 11” x 17” sheet with drawings information sized such that all drawing information is legible. The submittal drawings shall include the following:

1. Communications:
   a. Provide a one-line diagram depicting the system architecture complete with a communication riser and peripheral devices.
   b. Provide a tabular listing of locations of controlled equipment, communications and network wiring layout, and panel locations with unit communication address identifiers.

2. Point-to-point wiring diagrams for each HVAC system accurately depicting:
   a. Complete termination and configuration of all wiring and pneumatics. (this includes termination points for wires that are terminated on equipment supplied by others.)
   b. All temperature controls located on a schematic diagram of the controlled HVAC system
   c. Start-stop wiring for each piece of equipment
   d. Equipment interlocks
   e. Wiring terminal numbers
   f. Any special connection information required for properly controlling the mechanical equipment.

3. Panel interior and panel face layouts.
B. A bill of material reference list with drawing tag identifiers, application description, manufacturer, complete model number, and quantity.

C. Identify all deviations from this standard and project documents.

D. Provide written sequences of operation which shall define all modes control strategies.

E. The submittals shall include manufacturers catalog data describing each item of control equipment or component provided and installed for the project.

1.3 WARRANTY

A. The bas shall be warranted to be free from defects in both material and workmanship for a period of one (1) year of normal use and service. This warranty shall become effective the date the university accepts the system. The warranty shall include 24 hour per day, 7 day per week emergency problem response and all standard service contract preventative maintenance items (i.e. sensor calibration, linkage adjustment, etc.). An emergency service number shall be provided to the university. Response shall be within four (4) hours to the phone call.

B. Provide factory trained technicians familiar with the installation for emergency warranty service.

C. Upgrades: include all controller firmware and software updates for the installed system version at no additional cost to the system the university during the warranty period.

D. Tuning: include seasonal fine-tuning of PID loop parameters and other control parameters to provide an optimized control system to the university.

1.4 QUALITY ASSURANCE

A. Installation

1. The control system shall be furnished, engineered, and installed by the bas manufacturer’s local office.

2. Certain wiring and pneumatic installation may be performed by the bas installer/manufacturer’s approved subcontractor under the direct supervision of the bas installer/manufacturer’s field management.

B. Control system components shall be new and in conformance with the following applicable standards for products specified.

1. American society for testing and materials, ASTM
2. Institute of electrical and electronic engineers, IEEE
3. National electrical manufacturers association, NEMA
4. Underwriters laboratory, UL 916
5. Underwriters laboratory, UL 855 (smoke control only)
6. FCC regulation, part 15, section 156
7. National fire protection association, NFPA
8. Applicable building codes

1.5 SYSTEM DESIGN REQUIREMENTS

A. Campus building automation system design intent.

1. Provide a single vendor, stand-alone building automation system (bas) within each new or retrofitted building. Integrate the stand alone systems via the campus bas data network.
2. Systems shall be designed to be Bacnet compatible.
3. System shall be designed as an effective easy to use tool to operate, control, monitor and alarm mechanical equipment.
4. The system shall include all DDC controllers, sensors, valves, actuators, dampers, transmission equipment, software, local workstations, local panels, installation, setup, engineering, supervision, acceptance testing, training, and warranty necessary for a complete operable system.
5. The bas shall be a full control system designed to control terminal equipment as well as main systems.
6. Each building and or renovation project shall provide adequate devices for monitoring and operating the bas.
7. Each building shall include one or more bas workstations to, based on password, allow full access to system configuration and monitoring.

B. SYSTEM ARCHITECTURE

1. The bas control system architecture shall be comprised of four levels of DDC controls devices.
   a. Level 1: the first level is the system instrumentation component devices that includes but is not limited to sensors, valves, actuators, switches, relays, and transducers.
   b. Level 2: the second level includes the terminal equipment DDC controllers with specific applications for control of terminal units such as vav boxes, fan coils and unit heaters.
   c. Level 3: the third level is comprised of general application DDC controllers for control of large primary mechanical systems such as air handling systems, heating hot water systems and chilled water systems. This level also performs system networking functions.
   d. Level 4: the fourth level consists of a file server, workstations and other devices that provide access, programming and setup tools, database management and other functions.
   e. Provisions for expansion of all levels of the DDC system shall be provided with each project such that a need for future “gateway” or “repeater” expansion hardware and software is not required.

2. Alternates:
   a. Variations from this general outline should meet the following functionality and be approved by the university.
b. Non-intelligent slave panels may be utilized only to expand the controller point capacity for control of a single HVAC system, or specified monitoring not requiring control logic.

1.6 MANUFACTURERS

A. The existing DDC system is Siemens Building Technologies. All controls work and devices shall be provided by Siemens Building Technologies.

1.7 SYSTEM AND CONTROLLERS

A. All systems shall be configured and designed to be stand-alone.

B. All outputs including all outputs attached to terminal equipment controllers and special applications shall be directly commandable by the system operator. Any application that has outputs that cannot be commanded by the operator shall not be accepted.

1.8 SYSTEM AND CONTROLLERS

A. Terminal equipment controller hardware

1. General:

   a. Each terminal equipment controller shall be a stand-alone DDC controller designed specifically for terminal unit control such as VAV boxes, fan coil units, heat pump units or similar application.

   b. The controller shall execute local control sequences, independent of a network controller or workstation.

   c. All controllers shall preserve setup and programming from a loss of power for a minimum of 7 days.

2. Programs:

   a. The control program shall reside in the terminal equipment controller.

   b. The default data base, i.e. setpoints and configuration information, shall be stored in EEprom or other non-volatile memory.

3. Stand-alone:

   a. Controllers that share processing with a “master controller” shall not be acceptable.

   b. After a power failure the terminal equipment controller must run the control application without having to contact another controller.

4. Communications: communications to the general application controller shall maintain the specified network throughput speed specified in the network controller hardware section.
5. Isolation: operation shall be protected against electrical noise of 5 to 120 hz and from keyed radios up to 5 watts at 3 feet.

6. Connections:
   a. All electrical connections shall be made to a combination terminal strip and base assembly.
   b. To insure long term reliability, all electrical terminations shall be screw type.

B. Terminal equipment controller software

1. Controllers shall be provided with the capabilities required by the application.
2. Each input, output or calculation result shall accessible from the terminal equipment controller communication port, application controllers and workstations.
3. Controllers that require an eprom burn to make permanent changes to the software configuration shall not be acceptable.
4. All outputs for all controlled devices shall be directly commandable from the general application or network controller and from any workstation.
5. Global commanding of outputs and setpoints shall be available to command any number of similar terminal equipment controller outputs to the same position with a single command.
6. Terminal device controllers that do not allow separate space heating and space cooling setpoints to be configured shall not be accepted. This includes setpoint dial applications.

1.9 GENERAL APPLICATION CONTROLLERS

A. Hardware

1. General:
   a. The controller shall support all of the standards for the front-end software such as trending, alarming, etc.
   b. The general application controllers shall be a local control loop microprocessor-based controllers installed at each mechanical system; (i.e., air handling units, heating plants, chiller plants, etc.).
   c. The controller provides uplink and downlink communications, polling and other supervisory functions for terminal equipment controllers.
   d. Mechanical systems in close proximity with a small number of physical inputs and outputs may be combined in controllers with modular input output layouts.
   e. The controller shall be a true no-host system that does not require a pc or “host” computer to perform any control functions or communication.
   f. Each controller shall be addressable by a workstation or a portable service tool.
   g. Non-intelligent slave panels may be utilize only to expand the controller point capacity for control of a single HVAC system, or monitoring without control logic.
h. Self diagnostics: the controller shall contain in its program, a self-test procedure for checking communications and, verify the functionality of the cpu memory.

i. All equipment located on the roof shall be provided with an extra data drop for laptop connection. Locate roof mounted equipment in conditioned enclosures.

2. Each controller shall be provided with the memory capacity to store 1000 data samples for each physical analog point and 100 data samples for each physical digital point attached to it (including all expansion boards) and 400 data samples for each terminal equipment controller attached. This shall be in addition to the memory needed for all other functions of the panel.

3. Power loss/restart: the controller shall be tolerant of power failures. The memory shall be nonvolatile or unit shall hold memory for a minimum of four hours.

   a. Automatically and without operator intervention, the controller shall execute these restart procedures:

      1) Come on line
      2) Update all monitored functions
      3) Implement special building start-ups strategies as required
      4) Resume operation based on current time and status

   b. Controllers with batteries shall provide an alarmable point to the front end workstations when the batteries need to be replaced.

4. Network:

   a. Each general application controller shall connect to the campus Ethernet system.

   b. Multiple system workstation operators shall be able to access the controller simultaneously. Systems which do not provide multi-tasking, multi-user operating systems shall not be acceptable.

   c. Communication speed of each network shall have a maximum 10 second end-to-end throughput from a level 1 device input to a level 1 device output, anywhere in the system. Provide a system configuration that will maintain this minimum throughput speed during trend collection, recovery from power outages, and monitoring of multiple mechanical systems. Strategies to limit traffic shall not interfere with control or system monitoring.

   d. Uploading trends shall not interfere with control or monitoring operations

5. Isolation

   a. Control, communication and power circuits for each controller shall be individually electrically isolated to protect against transients, spikes, and power surges.
b. The ports shall be optically and/or electrically isolated from each other, the controller circuit board and from power wiring.
c. The controller shall be able to operate at 90% to 110% of nominal voltage rating.
d. Operation shall be protected against electrical noise of 5 to 120 HZ and from keyed radios up to 5 watts at 3 feet.

6. Servicing
   a. For ease of servicing, each controller shall consist of a removable plug-in circuit board.
   b. Products which require disconnection of wiring from the general application controller logic card before removal shall supply and install a quick disconnect type interconnection.
   c. If an air handler is located on the roof, locate equipment in conditioned enclosure of air handler.

7. Input/output modules:
   a. Analog inputs shall accept industry standard analog signals such as 4-20 ma, 0-5 VDC, and 0-10 VDC.
   b. Digital inputs shall accept binary contact closures.
   c. Digital outputs may be form c, latched or momentary contact type as required by the application.
      1) Digital output pairs controlling a tri-state motor/transducer or pulse width modulation shall not be utilized by general application controllers.
      2) Provide all digital outputs with hand/off/auto switches and led status indication.
   d. Analog outputs shall have a 1% resolution over total output span of 0 to 100%.
      1) Provide all analog outputs with manual override switches and pot adjustments.
   e. Provide each control panel with a minimum 10% spare of each input and output type.

B. General application controller software:
   1. Provide complete controller software to execute all mechanical system local loop controls functions.
   2. Controllers that require an Eprom burn to make permanent changes to the software configuration shall not be acceptable.
   3. Each input, output, or calculation result shall be capable of being assigned to the network controller for system networking.
4. Each controller shall be fully programmable both from a portable service tool at the controller and through the network communication system from the front-end workstation. Programs shall be able to be changed online without effecting other programs or point monitoring.

1.10 INSTALLATION, GENERAL

A. Provide a project manager who shall, as part of his duties, be responsible for the following:

1. Coordination between the contractor and all other trades, the university, local authorities, and the design team.
2. Scheduling of manpower, material delivery, equipment installation and checkout.
3. Maintenance of construction records such as project scheduling and manpower planning and autocad for project co-ordination and project record drawings.
4. Mount all panels at eye level in a workmanlike manor.

1.11 System setup

A. Nomenclature: all point names shall comply with the existing point naming conventions. See section 23 05 53 and the standard points list.

B. Point setup

1. For expansion of existing bas systems to new mept equipment, match the points list of similar hardware existing in the building.

2. All physical analog outputs shall be setup to be commandable from the graphics with units of percent open to the energy source. This means mixed air dampers will be in percent open to outside air. The value of the physical units of the output shall also be available as live data.

3. Points shall be setup so they read on reports and graphics with standard engineering units and without decimal places that exceed point updating or sensor accuracy.

4. A graphic link will be installed for all points that are alarmed to allow drag and drop of alarms from the alarm status application to the appropriate graphic panel.

C. Trends

1. All general application controller physical points, setpoints, and points on graphics shall be trended.

2. All trends shall be scheduled for data transfer from the field panels to the database without data loss and without interfering with system operation.
3. For archiving purposes, trends shall be setup to automatically transfer from the system database to files that can be easily used by standard spreadsheets.

4. Analog points should have an interval trend of 15 minutes, 200 samples at the panel, and 45 days in the database.
   a. A change of value style of trend will be setup to record significant changes between the fifteen minute intervals.

5. Digital points shall have change of value trends with a minimum of 50 changes from on to off or off to on stored in the panel, and 500 at the database or as needed for 45 days of data. Additionally, interval trend of 15 minutes, 200 samples at the panel, and 45 days at the database.

D. Locations

1. The room number for the mechanical system shall be on the graphic. Where points on the graphic are not in the same room as the system, the location shall be in the point setup that can not be accidently deleted during manual manipulation of the point or on the graphic.

E. Graphics

1. Graphics for renovation projects shall match existing graphics for similar equipment.

F. Alarms

1. Alarms for renovation projects shall match existing alarms for similar equipment.

G. Database

1. After all punch list items have been completed export all of the following items and turnover to ucd:
   a. All points for every panel, including virtual points
   b. All terminal device points
   c. All programs
   d. All panel database files

H. Reporting

1. Create the following reports:
   a. Trend collection report
   b. Operator report
   c. Failed point report
2. For archiving purposes, fifteen minute interval reports should be setup for each mechanical system. Once a month they should automatically export last month’s data to a csv file on the file server. File names will be organized logically and include the date and system.

I. Graphing

1. Create the following graphs:
   a. Historical graph for the last 45 days of performance for each major mechanical system.
   b. Dynamic graph of performance for each major mechanical system.

1.12 SYSTEM SETUP

A. Contractor shall provide to the engineer and the university a training class outline prior to any schedule training.

B. The control contractor shall conduct on-site training courses for designated university personnel in the maintenance and operation of the control system.

1. A minimum of one class shall be given upon system acceptance. Classes shall be no longer than four hours in duration and budgeted at 1 hour of training time per 4000 sq. Ft. Of controlled area in labs and 1 hour per 7500 sq. Ft. In office space. A minimum of one four hour class shall be provided.

2. Before training begins the O&MS shall be complete the project bas shall be communicating to the campus bas.

3. Training sessions shall be provided for the university’s personnel by factory trained personnel knowledgeable about all aspects of the installation.

4. Training outline shall be coordinated with university engineering and shall include as a minimum:
   a. Instruction on specific systems and instructions for operating the installed system
   b. A tour of the installation to show the location of all system components
   c. A review of the project documentation.
   d. A review of the sequences of operation.
   e. A review of graphical commanding and alarming.
   f. A review of the troubleshooting procedures
   g. A review of terminal controller operations.
   h. A review of emergency operation due to utility loss (power, chilled water, steam), panel failures, and major mechanical or electrical systems.
   i. A review of the o&ms and the working construction drawing set from the installation subcontractor.

5. Provide 8 hours total of seasonal loop tuning.
C. The bas contractor will provide, at no cost to the university, standard training for the operations staff. Such training shall be adequate to fully enable the student to perform any required operating procedures in the bas.

1.13 DEMOLITION

A. Demolition of an existing control system will include removal of controls which do not remain as part of the bas, all associated abandoned wiring and conduit, and all associated pneumatic tubing.

B. The university project manager will inform the bas contractor of any equipment which is to be moved that will remain the property of the university. All other equipment which is removed will be disposed of by the bas contractor.

C. Existing controls which are to be reused must each be tested and calibrated for proper operation.

D. Existing controls which are specified to be reused and are found to be defective requiring replacement will be noted to the university project manager. If necessary a change order will be issued to the contractor for repair or replacement of the defective device.

END OF SECTION
SECTION 23 09 13 – INSTRUMENTATION AND CONTROL DEVICES

1.1 SUMMARY

A. This section is an extension of 23 09 00. Reference this specification for control systems and procedures.

B. The devices listed in this section are control system field devices generally connected to the building automation system. These devices have been placed in a separate section for clarity. See section 23 09 00 for system standard and for items not clarified in this section.

C. Include all required factory and field calibration of each instrumentation device to accurately measure and control the desired variable.

D. All wiring requirements in this section shall be considered in addition to the requirements in division 26 not in place of division 26.

1.2 PRODUCTS

A. All input and output devices will be of the type which are universally accepted in the industry, can easily be second sourced and are fully compatible with the bas.

B. Required components:

1. All components shall be included to meet the intent of sections 230900 and 230913.
2. Pilot positioners shall be included where necessary to assure smooth operation of all analog pneumatic outputs.

1.3 MATERIALS AND EQUIPMENT:

A. General: the contractor shall provide control products in the sizes and capacities indicated. The existing control system shall remain and be reused as is. Additional controllers, sensors, and devices which are required to make a complete control system shall be the responsibility of the controls contractor.

1.4 SYSTEM INPUTS OR MEASUREMENT DEVICES:

A. General

1. All sensor and signal conditioning equipment will be of the type which are universally accepted in the industry, can easily be second sourced and are compatible with all of the manufacturer’s equipment.
2. See section 230913 for required points.
3. Provide components that are fully compatible with the building automation system (bas). Include all required factory and field calibration of each instrumentation device to accurately measure the desired variable.
4. All sensors to be installed in conditioned areas to prevent damage to the device. All devices to be installed in areas within the operating range of the device.

B. Air velocity sensors for VAV box control:

1. General:
   a. The sensor shall sense a velocity range that is appropriate for each box.
   b. Repeatability including transmitter shall be +/- 5% of the CFM reading across the range of flow required by the application.
   c. The consultant shall determine if the airflow transmitter included in the controller will meet the above accuracy and specify an external transmitter where necessary.

2. Performance:
   a. Thermal anemometer sensors shall use constant temperature differential technology and operate from 30F degree F to 120 F Degrees F.
   b. Differential pressure sensors shall provide periodic auto-calibrate to insure accurate velocity pressure measurement at low flows.

C. Damper actuators for VAV box terminal unit control:
   a. Provide a rotary type capable of permanent stall operation without damage.
   b. Provide adjustable stop pins on the actuator for stroke limit.
   c. The actuator shall fit directly over the damper shaft.
   d. VAV terminals 3,000 CFM or greater must be provided with high torque actuator.

1.5 EXECUTION

A. Remote control devices not in local panels shall be accessible for adjustment and service below 7’ above finished floor whenever possible.

B. All transducers, transmitters, relays, etc., shall be mounted in a panel with hinged doors in an orderly manner and shall be properly labeled with permanent labels to identify the parts of the system being served. All thermostats shall be labeled with device number and point address.

C. All transducers, transmitters, relays, etc., shall be mounted in a panel with hinged doors in an orderly manner and shall be properly labeled with permanent labels to identify the parts of the system being served. All thermostats shall be labeled with device number and point address.

1.6 SYSTEM INPUTS OR MEASUREMENT DEVICES

A. Air velocity sensors for terminal box control: the terminal box air flow measurement needs to be installed with the minimum duct diameters to assure accurate measurement of minimum ventilation air flow.
1.7 AUXILIARY EQUIPMENT

A. Wiring installation methods

1. General
   a. At a minimum, install systems and materials in accordance with manufacturer’s instructions, rough in drawings and equipment details.
   b. Install electrical components in compliance with requirements of applicable sections of division 26.
      Install all control wiring 50 volts and above in conduit.

2. Installation
   a. All control wiring shall be installed in a neat and workmanlike manner parallel to building lines, with adequate support and shall be supported from or anchored to structural members.
   b. Conduit supported from or anchored to piping, duct supports, the ceiling suspension system, or other electrical conduits are not acceptable.
   c. Wiring buried in slab on grade concrete or explosion proof areas shall be in rigid metal conduit.
   d. Provide adequate strain relief for all field terminations.
   e. Varistors shall be installed on the control side of all output relays and on both sides of the transformers.
   f. All terminations shall be neat with no stray strands.
   g. An additional number of spare wires shall be included in each run as determined by the university for future use.

B. Identification:

1. General
   a. Verify label nomenclature with the university before engraving or printing.
   b. All control equipment shall be individually and clearly identified by control shop drawing designation:
   c. Paper labels are not acceptable.

2. Control panels
   a. Provide engraved Bakelite or lithographed metal nameplates with panel number and system served
   b. Utilize white ½ inch high letters on a black background.
   c. Embossed labels are not acceptable

3. Component sub-panels – metal tags or laser printed, adhesive backed, metallized polyester film labels.

4. Control valves and damper actuators – brass tags or engraved Bakelite tags.
5. Other remote control devices – metal tags or laser printed, adhesive backed, metallized polyester film labels.


7. Label room temperature sensors with point name and address of the terminal controller served by the sensor.

8. For all control devices located above the ceiling attach an additional label to the ceiling “T” frame with pop rivets. Use engraved nameplates, 3”x1”, black lettering on white background.

9. Number-code conductors and pneumatic tubing appropriately for future identification and servicing of control system. Reflect this tagging or color coding system on the project record documents.

C. VFD interface wiring.

1. All safety circuit and bas control wiring to VFDs shall be connected to a terminal strip in a NEMA enclosure external to the drive before entering the drive. This is to allow servicing these circuits without opening the drive.

END OF SECTION
SECTION 23 09 93 - SEQUENCE OF OPERATION FOR HVAC CONTROLS

1.1 GENERAL:

A. Sequence of operation is hereby defined as the manner and method by which controls function. Requirements for each type of control system operation are specified in this section.

B. Operating equipment, devices, and system components required for control systems are specified in other division 23 controls' sections of these specifications.

1.2 SYSTEM REQUIREMENTS:

A. The existing Siemens building automation system shall be used and extended to achieve the sequence portion described herein.

B. Controls contractor shall adjust the minimum VAV box settings. Coordinate as needed with balancing contractor to verify flow sensors are measuring properly.

C. Provide control systems consisting of thermostats, control valves, dampers, operators, indicating devices, interface equipment, and other apparatus required to operate mechanical system and to perform functions specified.

D. Provide necessary materials and field work necessary to connect control components factory supplied as part of equipment controlled, unless specified otherwise. Generally, self-contained valves, filter gauges, liquid level controllers and similar instruments, are not to be installed under this section.

E. Unless specified otherwise, provide fully proportional components. Terminal box controllers do not have to have fully proportional components.

F. Provide all necessary relays and signal boosters to make the system a full and operable system as required by the sequence of operation.

1.3 CHILLER CONTROL SEQUENCES:

A. Water Cooled Imaging Equipment Chiller: The chiller shall be enabled by the imaging equipment DLHE and shall run continuously. Provide all control connections necessary to monitor status of DLHE and enable chiller when gradient/magnet pump is enabled if no such contacts are available, or as otherwise instructed by imaging equipment vendor. Provide solenoid valve per detail and enable valve open when chiller is enabled.

1.4 FAN COIL UNIT CONTROL SEQUENCES:

A. Chilled Water Fan Coil Units: Provide wall mounted thermostat to automatically modulate the normally closed cooling coil control valve and cycle the fan motor to maintain the space thermostat heating and cooling settings.
1.5 TERMINAL BOX CONTROL SEQUENCES:

A. Retain the existing sequences for this project.

END OF SECTION
SECTION 23 22 00 – PIPING

1.1 SUBMITTALS:

A. Refer to division 1 of the base contract with the owner and basic mechanical requirements for administrative and procedural requirements for submittals.

B. Product data: submit industry standards and manufacturer's technical product data, installation instructions, and dimensioned drawings for each type of pipe and pipe fitting. Submit piping schedule showing pipe or tube weight, fitting type, and joint type for each piping system.

C. Brazing certifications: submit reports as required for piping work.

1.2 QUALITY ASSURANCE:

A. Welders Qualifications: All welders shall be qualified in accordance with ASME Boiler and Pressure Vessel Code, Section IX, Welding and Brazing Qualifications

B. Welding procedures and testing shall comply with the latest revisions of the applicable sections for B31, of the ANSI/ASME standard codes for pressure piping, noted as “B31.9 Building Services Piping”.

C. The types and extent of non-destructive examinations required for pipe welds are as shown in Table 136.4 of the ASME Code for Pressure Piping, ANSI/ASME B31.1 - Power Piping. If requirements for non-destructive examination are to be other than that stated above, the degree of examination, and basis for rejection shall be a matter of prior written agreement between the fabricator, of contractor and the purchaser.


E. Welding: All welding work shall be performed by welders certified to ASME or AWS standards within the last year for the type of material and application suited for the job. Contractors shall submit copies of qualification tests of the welders to the Project Manager prior to construction.

F. ASME B31.9 “Building Services Piping” for materials, products and installation. Safety valves and pressure vessels shall bear the appropriate ASME label.

1.3 MANUFACTURERS:

A. Manufacturer's qualifications: firms regularly engaged in manufacturer of pipes and pipe fittings of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

1. Grooved Piping:
   a. ITT Grinnell Corp.
   b. Victaulic Co. of America

2. Piping Connectors
a. Fernco, Inc.
3. Pipe Thread Sealant
   a. The Rectorseal Corp.

1.4 MATERIALS, GENERAL:

A. Piping materials: provide pipe and tube of type, pressure and temperature ratings, capacities, joint type, grade, size and weight (wall thickness or class) indicated for each service. Where type, grade or class is not indicated, provide proper selection as determined by installer for installation requirements, and comply with governing regulations and industry standards.

B. Pipe/tube fittings: provide factory fabricated fittings of type, materials, grade, class and pressure rating indicated for each service and pipe size. Provide sizes and types matching pipe, tube, valve or equipment connection in each case. Where not otherwise indicated, comply with governing regulations and industry standards for selections, and with pipe manufacturer’s recommendations where applicable.

C. Provide piping systems with drain valves at low points of piping, bases of vertical risers, and at equipment.

D. General: working pressure and temperature maximums, 125 psi and 250 degrees f; water service.

E. Steel Pipes and Pipe Fittings:
   1. Black Steel Pipe: ASTM A53, Grade B, Type E, electric resistance welded.
   2. Galvanized Steel Pipe: ASTM A 53, Grade B.
   3. Seamless Steel Pipe: ASTM A53, Grade B, type S or A106 high temperature.
   4. Stainless Steel Pipe: ASTM A312; Grade TP 304 (high temperature and corrosive service, 1/8-inch through 30-inch).
   6. Cement-Mortar Protective Lining and Coating for Steel Pipe: AWWA.
   7. Steel Water Pipe: AWWA for pipe 6-inch and larger.
   8. Cast-Iron Flanged Fittings: ANSI B16.1, including bolting (class 125 and 250)
   9. Cast-Iron Threaded Fittings: ANSI B16.4; plain or galvanized as indicated (Class 125 and 250)
   10. Malleable-Iron Threaded Fittings: ANSI B16.3; plain or galvanized as indicated (Class 125 and 300)
11. Malleable-Iron Threaded Unions: ANSI B16.30, Class 150, 250 or 300; selected by Installer for proper piping fabrication and service requirements, including style, end connections, and metal-to-metal seats (iron, bronze or brass); plain or galvanized as indicated (Class 150, 250 and 300).


13. Steel Flanges/Fittings: ANSI B16.5, ASTM A234 (Fire Protection) including bolting and gasketing of the following material group, end connection and facing, except as otherwise indicated.

14. Corrosion-Resistant Cast Flanges/Fittings: MSS SP-51, including bolting and gasketing (threaded where pressure is not critical).

15. Forged-steel Socket-Welding and Threaded Fittings: ANSI B16.11, except MSS SP-79 for threaded reducer inserts; rated to match schedule of connected pipe up to 4 inch pipe size).


18. Forged Branch-Connection Fittings: Except as otherwise indicated, provide type as determined by Installer to comply with installation requirements.

19. Pipe Nipples: Fabricated from same pipe as used for connected pipe; except do not use less than Schedule 80 pipe where length remaining unthreaded is less that 1-1/2 inch and where pipe size is less than 1-1/2 inch, and do not thread nipples full length (no close nipples).

F. Copper Tube and Fittings:

1. Copper Tube: ASTM B 88; Type K or L as indicated for each service; hard-drawn, except as otherwise indicated.

2. DWV Copper Tube: ASTM B306

3. ACR Copper Tube: ASTM B280.


6. Cast-Copper Solder-Joint Drainage Fittings: ANSI B16.23 (drainage and vent with DWV or tube).


8. Cast-Copper Flared Tube Fittings: ANSI B16.26
9. Bronze Pipe Flanges/Fittings: ANSI B16.24 (Class 150 and 300)

10. Copper-Tube Unions: Provide standard products recommended by manufacturer for use in service indicated.

G. Brass Pipe and Fittings:
   1. Red Brass Pipe: ASTM B43 (boiler feed pipe, 1/8 inch through 12 inch, regular or extra strong weight)
   2. Cast-Bronze Threaded Fittings: ANSI B16.15, Class 125 or 250.

H. Grooved Piping:
   1. Coupling Housings: Malleable iron conforming to ASTM A47.
   2. Coupling Housings: Ductile iron conforming to ASTM A536.
   3. Coupling Housings Description: Grooved mechanical type, which engages grooved or shouldered pipe ends, encasing an elastomeric gasket which bridges pipe ends to create seal. Cast in two or more parts, secure together during assembly with nuts and bolts. Permit degree or contraction and expansions specified in manufacturer’s latest published literature.
   4. Gaskets: Mechanical grooved coupling design, pressure responsive so that internal pressure serves to increase the seal’s tightness, constructed of elastomers having properties as designated by ASTM D2000.
      a. Water Services: EDPM Grade E, with green color-code identification.
      b. Other Services: As recommended by Manufacturer.
   6. Branch Stub-ins: Upper housing with fill locating collar for rigid positioning engaging machine-cut hole in pipe, encasing elastomeric gasket conforming to pipe outside diameter around hole, and lower housing with positioning lugs, secured together during assembly with nuts and bolts.
   7. Fittings: Grooved or shouldered end design to accept grooved mechanical couplings.
      a. Malleable Iron: ASTM A47
      b. Ductile Iron: ASTM A536
      c. Fabricated Steel: ASTM A53, carbon steel, Schedule 40, Type F, for 3/4 inch to 4 inch; Type E or S, Grade B for 5 inch to 20 inch.
      d. Steel: ASTM A234
      e. Wrought Copper and Bronze: ASTM B75 tube and ASTM B584 bronze castings.

8. Flanges: Conform to Class 125 cast iron and Class 150 steel bolt holes alignment.

9. Grooves: Conform to the following:
   b. Lightweight Steel: Roll grooved.

I. Miscellaneous Piping Materials/Products:


2. Soldering Materials: Lead-free solder

3. Brazing Materials: Except as otherwise indicated, provide brazing materials to comply with installation requirements.
   a. Comply with AWS A5.8, Section II, ASME Boiler and Pressure Vessel Code for brazing filler metal materials.
      1) Copper phosphorus – Bcup
      2) Silver - BAg minimum 4% Silver content

4. Gaskets for Flanged Joints: ANSI B16.21; full-faced for cast-iron flanges; raised-face for steel flanges, unless otherwise indicated.

5. Pipe Thread Sealant Material: Except as otherwise indicated, provide all pipe threads with the sealant material as recommended by the manufacturer for the service.

J. Piping Systems:

1. Domestic Hot and Cold Water:
   a. Above Grade, Inside Buildings: Type L, hard drawn copper tube with wrought copper or bronze fittings, lead free solder joints or Schedule 40, galvanized steel pipe A53 grade B, ERW w/galvanized Grooved end fittings.
   b. Below Grade, Inside and Outside Buildings: Underground outside fittings shall comply with City of Aurora standards.
1) 2 inches and Smaller: Type K, soft copper or Type K annealed copper tube with wrought copper fittings, silver brazed solder joints.
2) 2.5 inches and Larger: Class 250, tar coated outside, cement lined, cast iron or ductile iron with mechanical or push on joints.

2. Equipment drain and overflows: Type “M” or “DWV” copper.

3. Sanitary Sewer and Vents:
   a. Above Grade: Service weight cast iron, no-hub type with neoprene gaskets; service weight cast iron, hub and spigot type with neoprene gaskets; or DWV copper with wrought copper or cast brass fittings.
      1) Use heavy duty no hub couplings 4" wide 304 stainless steel shield, with six (6) stainless steel clamps mounted in series on the following:
         a) Sanitary vent piping 4" and larger.
         b) Sanitary piping 3" and larger.
         c) All storm piping.
      2) Torque to minimum 80 inch pounds or per manufacturer's recommendation.
      3) Acceptable manufacturers: Husky Series 4000 or Mission Heavy Weight.
   b. Below Grade: Sizes 2 inches to 20 inches, service weight cast iron, hub and spigot type with neoprene compression gaskets; or sizes 12 inches and larger ductile cast iron with neoprene gasket joints.
   c. Cleanout Openings: Two-way type, 1-1/4 inch nominal size minimum and located such that long lines can be entered from both ends. Lubricate plugs at installation.
   d. All sump pumps receiving floor drains located in boiler rooms will be non-submersible type. Pumps will be designed to handle hot water because boilers are flushed or emptied at intervals into floor sumps.

1.5 INSTALLATION, GENERAL

A. 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. Align piping accurately at connections, within 1/16-inch misalignment tolerance.

1. Comply with ANSI B31 Code for Pressure Piping.
2. Electrical Equipment Spaces: Do not run piping through transformer vaults and other electrical or electronic equipment spaces and enclosures. Only piping serving this type of equipment shall be allowed.
3. Use fittings for all changes in direction and all branch connections.
4. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.

5. Locate groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

6. Install drainage piping with a minimum 1/8 inch per foot downward slope in the direction of the drain and a maximum slope of ¼ inch per foot.

7. Install drains at all low points in mains, risers, and branch lines consisting of a tee fitting, ¾-inch ball valve, and short ¼-inch threaded nipple, hose connection, and cap.

B. Piping System Joints:

1. General: Provide joints of type indicated in each piping system.

2. Thread pipe in accordance with ANSI B2.1 Braze copper tube-and-fitting joints in accordance with ASME B31.

3. Weld pipe joints in accordance with ASME Code for Pressure Piping, B31. Provide weld-o-let fittings for two pipe sizes less than main pipe size.

4. Weld pipe joints as follows:
   a. Weld pipe joints only when ambient temperature is above 0 degrees F. (-18 degrees C)
   b. Bevel pipe ends at a 37.5-degree angle where possible, smooth rough cuts, and clean to remove slag, metal particles and dirt.
   c. Use pipe clamps or tack-weld joints with 1-inch long welds; 4 welds for pipe sizes to 10 inch, 8 welds for pipe sizes 12 inch to 20 inch.
   d. Build up welds with stringer-bead pass, followed by hot pass, followed by cover or filler pass. Eliminate valleys at center and edges of each weld. Weld by procedures, which will ensure elimination of unsound or un-fused metal, cracks, oxidation, blow-holes and non-metallic inclusions.
   e. Do not weld-out piping system imperfections by tack-welding procedures; re-fabricate to comply with requirements.

5. Weld pipe joints of steel water pipe in accordance with AWWA C206.

6. 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.

C. Pipe Fittings:

1. Place unions at all equipment, regulators, controls, etc., that require removal or replacement. Do not block removal with adjacent equipment or piping. Where
necessary for removal of equipment, install unions on both sides of equipment. Unions are not required on flanged devices.

2. Use dielectric waterway fittings where dissimilar metals are connected. Isolate building distribution gas piping with dielectric unions from gas main for cathodic protection.

3. All unions shall be ground joints.

4. Make reductions in size with reducing fittings.

5. All screwed nipples from copper fittings shall be red brass.

D. Pipe Connections: Install pipe connections to pumps, compressors, etc., with adequate allowance for movement and vibration. Support connections so the equipment does not carry weight.

E. Expansion Compensation: Arrange pipes and equipment with due regard for the effects of thermal expansion.

F. Hangers and Supports:

1. Maintain uniform grading and pipe slope of piping system. Install supports between piping and building structure to prevent swaying and vibration. Install hangers to provide a minimum 1/2-inch clear space between finished covering and adjacent work. Use threaded rods with two lock nuts.

2. Do not support weight of piping from mechanical equipment, ductwork, pump flanges, coil connections, and related items.

3. Support hanger rods by coach screw rods, angle iron clips, or beam clamps. No drilling of structural members will be permitted without approval. Hanger rods shall be attached to the top of joist beams.

4. Do not bend hanger rods to provide alignment of piping offset from overhead supports.

5. Provide sway bracing every 40 feet on cast iron.


7. Vertical Supports
   a. Cast Iron Pipe: Support at each floor, not to exceed 15 feet between supports, and at pipe base.
   b. Screwed Pipe: Support at 8 foot on center for 1-1/2 inch and smaller pipe. Support at 10 foot on center for 2-inch and larger pipe.
   c. Copper Pipe: Support at 6 foot on center for 1-1/2 inch and smaller pipe. Support 8 foot on center for 2-inch and larger pipe.

8. Trapeze Hangers: Space for smallest pipe in-group. Provide additional hanger rod at mid span where trapeze length exceeds 4 feet. Secure pipe at each trapeze with standard pipe strap. Rest un-insulated copper pipe on neoprene sleeves.

G. Pipe Joint Construction:

1. Soldered Joints: Comply with the procedures contained in the AWS “Soldering Manual”.

2. Brazed Joints: Comply with the procedures contained in the AWS “Brazing Manual”. CAUTION: Remove stems, seats, and packing of valves and accessible internal parts at piping specialties before brazing.

3. Fill all medical gas and refrigerant pipe and fittings during brazing with an inert gas, i.e., nitrogen or carbon dioxide, to prevent formation of scale.
5. For all copper piping, ream and remove all burrs prior to making joints.
7. Damaged Threads: Do not use pipe with threads that are corroded or damaged. If a weld opens during cutting or threading operations, that portion of pipe shall not be used.
8. Welded Joints: Comply with the requirement in ASME Code B31.9 “Building Services piping”.
9. Flanged Joints: Align flanges surfaces parallel. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.

1.6 TESTING, CLEANING, AND CERTIFICATION

A. Test all piping systems in accordance with tests outlined in individual sections. Provide temporary equipment for testing, including pump and gages. Test each natural section of each piping system independently but do not use piping system valves to isolate sections where test pressure exceeds valve pressure rating. Test all new piping and parts of existing piping that have been altered extended or repaired. Submit report(s) on the results of each test.

B. Give a minimum of twenty-four hours notice to the Engineer for dates when acceptance test will be conducted. Conduct tests as specified for each system in presence of the University Project Manager or representative of agency having jurisdiction. Submit three (3) copies of successful tests to the Engineer for his review. Report shall state system tested and date of successful test.

C. Compressed air tests may be substituted for hydrostatic tests only when ambient conditions or existing building conditions prohibit safe use of hydrostatic testing and must be reviewed by the Engineer prior to any testing.

D. Remove equipment not able to withstand test procedure during test.

E. For piping, which is to be concealed, piping shall remain uncovered until tests have been completed.

F. Drain test water from piping systems after testing and repair work has been completed.

G. Repair piping systems sections that fail testing, by disassembly and re-installation, using new materials to extent required to overcome leakage. Do not use chemicals, stop-leak compounds, mastics or other temporary repair methods.

H. Potable Water Piping System:

1. Cap domestic water piping and subject piping to static water pressure of 50 psig above operating pressures or 150 psig maximum without exceeding pressure rating of piping system materials. Allow the system to remain pressurized for 4 hours. Correct leaks and loss in pressure and retest system.
2. Disinfect all domestic hot and cold water systems upon completion of final piping installation. Following disinfection, flush water from system through its extremities. Continue flushing until samples show quality is comparable with public water supply and complies with requirements of public health authority.

I. Sanitary Sewer Pipe Testing:

1. Test drain, waste, and vent piping on completion of rough in. Close openings in piping system and fill with water to point of overflow but not less than 10 feet of head. Water level must not drop from 15 minutes before inspection starts through completion of inspection. Correct leaks and retest system.

J. Adjusting and Cleaning:

1. General: Clean exterior surfaces of installed piping systems of superfluous materials, and prepare for application of specified coatings (if any). Flush piping systems with clean water. Inspect each run of each system for completion of joints, supports and accessory items.

2. Chemical Treatment: Provide a water analysis prepared by the chemical treatment supplier to determine the type and level of chemicals required for prevention of scale and corrosion. Perform initial treatment after completion of system testing.

3. Flush each new extension of existing systems, via hose connections prior to filling. Fill each new extension of existing systems with water that has the proper water treatment chemicals and in the proper quantity prior to connection, or opening valves to the main or existing system. Use chemicals that are compatible with the chemicals in the existing system. Flush each new system with the university representative present. Fill each new system with the proper chemicals, and with the university representative present.

1.7 COMMISSIONING (DEMONSTRATION)

1. Fill system and perform initial chemical treatment.

2. Check expansion tanks to determine that they are not air bound and that the system is completely full of water.

3. Before operating the system, perform these steps:


5. Remove and clean strainers.

6. Check pump for proper rotation and proper wiring.

7. Set automatic fill valves for required system pressure.

8. Check air vents at high points of systems and determine if all are installed and operating freely (automatic type) or to bleed air completely (manual type).
9. Set temperature controls so all coils are calling for full flow.

10. Check operation of automatic bypass valve.

11. Check and set operating temperature of converters and chillers to design requirements.

12. Lubricate motors and bearings.

END OF SECTION
SECTION 23 21 00 – HYDRONIC SYSTEMS

1.1 SUBMITTALS:

A. Refer to division 1 of the base contract with the owner and basic mechanical requirements for administrative and procedural requirements for submittals.

B. Product data: submit industry standards and manufacturer's technical product data, installation instructions, and dimensioned drawings for each type of pipe and pipe fitting. Submit piping schedule showing pipe or tube weight, fitting type, and joint type for each piping system.

C. Brazing certifications: submit reports as required for piping work.

1.2 QUALITY ASSURANCE:

A. Soldering and brazing procedures shall conform to ANSI standard safety code for mechanical refrigeration.

1.3 MANUFACTURERS:

A. Manufacturer's qualifications: firms regularly engaged in manufacturer of pipes and pipe fittings of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Automatic fill valves:

1. ITT BELL AND GOSSETT, MODEL B7-12

2. AMTROL, MODEL 11F

1.4 GENERAL:

A. Piping materials: provide pipe and tube of type, pressure and temperature ratings, capacities, joint type, grade, size and weight (wall thickness or class) indicated for each service. Where type, grade or class is not indicated, provide proper selection as determined by installer for installation requirements, and comply with governing regulations and industry standards.

B. Pipe/tube fittings: provide factory fabricated fittings of type, materials, grade, class and pressure rating indicated for each service and pipe size. Provide sizes and types matching pipe, tube, valve or equipment connection in each case. Where not otherwise indicated, comply with governing regulations and industry standards for selections, and with pipe manufacturer's recommendations where applicable.

C. Design piping systems with drain valves at low points of piping, bases of vertical risers, and at equipment.
D. In hydronic systems subject to freezing provide Dowfrost solution or pumped coils.

1.5 PIPES AND FITTINGS:

A. General: working pressure and temperature maximums, 125 psi and 250 degrees f; water service.

B. Copper pipe: ASTM b88-96, copper tubing, hard drawn, type k for underground lines and type l for above ground lines.
   1. Fittings: ASME b16.22-95, wrought copper solder joint.
   2. Joining material:
      b. Brazing: AWS a5.8-92, classification bag 1 (silver) for underground lines and where copper pipe is connected to brass.
   4. Flanges: class 125, cast iron or cast bronze flanges.
      b. Gaskets: ASME b16.21-92, nonmetallic, flat, 1/16-inch, full faced, for water service.
   5. Dielectric connections: fittings having insulating material isolating joined dissimilar metals.
      a. Dielectric waterway fittings: 175 psi minimum working pressure, ends to match connections
      b. Flanges: class 125, cast bronze, ASME standard, with bolt insulators, dielectric gasket, bolts, and nuts.

C. Steel pipe: ASTM a53-96, schedule 40, seamless black steel pipe.
   1. Fittings:
      a. Threaded: ASME b16.4-92, class 125, cast iron, or ASME b16.3-92, class 150, malleable-iron. standard pattern for threaded joints. threads shall conform to ASME b1.20.1-83.
         1) Flanged: ASME b16.1-89, class 125, cast iron, raised ground face, bolt holes spot faced.
         3) Grooved couplings and mechanical fittings: ASTM a536-84 ductile or ASTM a47-90 malleable iron, with enamel finish and grooves or shoulders designed to accept
D. General: working pressure and temperature maximums, 125 psi and 250 degrees f; water service.

E. Copper pipe: ASTM b88-96, copper tubing, hard drawn, type k for underground lines and type l for above ground lines.
   1. Fittings: ASME b16.22-95, wrought copper solder joint.
   2. Joining material:
      b. Brazing: AWS a5.8-92, classification bag 1 (silver) for underground lines and where copper pipe is connected to brass.
   4. Flanges: class 125, cast iron or cast bronze flanges.
      b. Gaskets: ASME b16.21-92, nonmetallic, flat, 1/16-inch, full faced, for water service.
   5. Dielectric connections: fittings having insulating material isolating joined dissimilar metals.
      a. Dielectric waterway fittings: 175 PSI minimum working pressure, ends to match connections
      b. Flanges: class 125, cast bronze, ASME standard, with bolt insulators, dielectric gasket, bolts, and nuts.

   1. Fittings:
      b. Flanged: ASME B16.1-89, class 125, Cast Iron, raised ground face, bold holes spot faced.
      d. Grooved couplings and mechanical fittings: ASTM A536-84 Ductile or ASTM A47-90 malleable iron, with enamel finish and grooves or shoulders designed to accept grooved couplings. Synthetic rubber gasket,
with central-cavity, pressure responsive design and ASTM A183-83 carbon steel bolts and nuts.


3. Dielectric waterway fittings: threaded end connections. Install to isolate dissimilar metals, prevent galvanic action, and prevent corrosion.

### 1.6 INSTALLATION, GENERAL

#### A. Copper Pipe:

1. Install type l copper pipe with wrought copper fittings and solder joints for 2-inch and smaller pipe, above ground, within building.

2. Install type k copper pipe for 2 inch and smaller pipe below ground.

#### B. Steel Pipe:

1. Threaded joints: install steel pipe with threaded joints and fittings for 2-inch and smaller in exposed locations such as mechanical rooms.

2. Welded and flanged joints: install welded fittings on pipe 2-1/2 inches and larger.

3. Grooved couplings and mechanical fittings: install mechanical grooved end pipe on condenser

#### C. Water Piping:

1. Arrange piping in horizontal groups, each group to be in one plane. Maintain indicated slope. conceal pipe installations in walls, pipe chases, utility spaces, mechanical rooms, above ceilings, below grade or floors.

2. Install piping in accordance with the stipulations in section 01040.

#### D. Sloping, Air Venting, And Draining:

1. Install piping true to line and grade, and free of traps and air pockets. slope piping up in direction of flow at 0.2 percent grade.

2. Provide eccentric reducers for changes in horizontal piping, top side flat.

3. Connect branch piping to bottom of mains, except for up-feed risers which shall have take-off out top of main.
4. Install manual air vents at high points in hydronic piping systems and at coils other than air handling units. Provide 1/4-inch copper, 180-degree bend pipe to discharge vented water into can.

5. Install automatic air vent on air separator, water coils at air handling units, and where shown. Provide valved inlet and discharge piped to floor drain.

6. Install drain valves with hose adapters at low points in mains, risers, and branch lines. Drain shall consist of a tee fitting, 3/4-inch ball valve, and short 3/4-inch threaded nipple and cap. Provide drain valves for float type controllers.

E. Fittings: standard manufactured fittings. Field fabricated fittings and bushings are prohibited on all piping.

F. Unions: install unions in pipes 2-inch and smaller, adjacent to each valve, at final connections of each piece of equipment and elsewhere to permit alterations and repairs. Install dielectric waterway fittings to join dissimilar metals. Unions are not required on flanged devices.

G. Pipe ends: cut pipes, remove burrs and prepare ends with full inside diameter.

H. JOINTS:
   1. Threaded joints: apply Teflon tape to male equipment threads. Do not use pipe with threads which are corroded or damaged.
   2. Soldered joints: comply with procedures contained in AWS soldering manual-98. Clean surfaces to be joined of oil, grease, rust, and oxides. Clean socket of fitting and end of pipe with emery cloth. After cleaning and before assembly or heating, apply flux to joint surface and spread evenly.

I. Keep openings in piping closed during construction to prevent entrance of foreign matter.

J. Install stainless steel flexible connectors at inlet and discharge connections to base-mounted pumps and other vibration producing equipment.

K. VALVES:
   1. Field check valves for packing and lubricant. Replace leaking packing. Service valves with lubricant for smooth and proper operation before placing in service.
   2. Install valves accessible from floor level, located for easy access. Install valves in horizontal piping with stem at or above center of pipe. Install valves in position to allow full stem movement. Provide operating handles for valves and cocks without integral operators.
   3. Provide extended valve stems where insulation is specified.
   4. Provide separate support where necessary.
5. Where soldered end connections are used for valves, use solder having a melting point below 840 degrees F for gate, globe, and check valves; below 421 degrees F for ball valves.

6. Provide valves same size as line size.

7. Provide gate blow-down valves and hose adapters at strainers; same size as strainer blow-off connection.

8. Provide mechanical actuators with chain operators where valves 2-1/2 inches and larger are mounted more than 6 feet above the floor. Extend chains to elevation of 5 feet above floor.

9. Check valves: install wafer or lift check valves on pump discharge. Install check valves for proper direction of flow as follows:
   a. Swing check valve: horizontal position with hinge pin level.
   b. Wafer check valve: horizontal or vertical position, between flanges.
   c. Lift check valves: with stem upright and plumb.

L. EQUIPMENT PIPING:

1. Provide combination balancing and shutoff valves to regulate water flow through piping, coils, and at other equipment and piping where shown or required for proportioning flow.

M. EXPANSION LOOPS, GUIDES, AND ANCHORS:

1. Install piping with provisions for expansion and contraction, using expansion loops. Provide for expansion and contraction in mains, risers, and run-outs. Install pipe expansion loops cold-sprung in tension for piping with operating temperatures higher than installed temperature and compression for piping with operating temperatures lower than installed temperatures. Install pipe to absorb 50 percent of total compression or tension produced during anticipated change in temperature. Do not bend piping without use of bending machine.

2. Install guides to properly direct pipe movement into expansion loops and offsets.

3. Install anchors to control movement in piping. Weld anchors to ferrous piping and braze anchors to nonferrous piping. Install pipe anchors at ends of principal pipe runs and at intermediate points in pipe runs between expansion loops.

4. Install in accordance with standards of expansion joint manufacturer's association, EJMA-93.
N. DRAIN PANS:

1. Provide drain pans under the entire length of any piping, including valves, joints, and fittings for any liquid-carrying piping system installed over any motor, motor starter, switch gear, transformer, or other electrical equipment. Also, under all such piping located anywhere in any transformer vault, electrical switchboard room, and telephone equipment room. drain pans shall be not less than 2 inches deep, with a 3/4-inch drain pipe to discharge where shown or to discharge at nearest convenient drain line, floor drain, or other approved drain point.

O. Expansion tank and air separator installation:

1. Expansion tank and air separator installation:

2. Install tanks as shown; locate appurtenances for easy servicing.

3. Install gate valve and union on air separator drain to facilitate removal of strainer. route discharge on air separator tank to nearest drain.

4. Check expansion tank after cleaning, testing, and filling of system to ensure system is completely full.

5. Provide bracket supports, saddles, and hangers to support tanks.

6. Install air separator level in both directions, supported from structure so that all pipe can be removed without moving tank.

7. Charge expansion tank with proper air charge.

1.7 TESTING, CLEANING AND CERTIFICATION

A. Test piping systems using ambient temperature water, except where there is risk of damage due to freezing.

B. Release trapped air while filling system using vents at high points. use drains installed at low points for complete removal of liquid.

C. Isolate equipment and parts that cannot withstand test pressures.

D. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the design pressure. test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test.

E. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. eliminate leaks by tightening, repairing, or replacing components and repeat hydrostatic test until there are no leaks.
F. Clean and flush hydronic piping systems. remove, clean, and replace strainer screens. after cleaning and flushing hydronic piping system, but before balancing, remove disposable fine mesh strainers in pump suction diffusers.

G. Mark calibrated name plates of pump discharge valves after hydronic system balancing has been completed, to permanently indicate final balanced position.

H. Prepare written report of testing, indicating locations of leaks corrected, method used to correct leaks, number of tests required, and certification that system is leak free.

1.8 COMMISSIONING (DEMONSTRATION)

A. Provide 2 hours of instruction on hydronic systems. Include following items as a minimum:

1. Location of automatic and manual air vents.
2. Location of strainers and blow down valves.
3. Location of safety and relief valves.
4. System drain valves.
5. System fill and associated devices.
6. Expansion tank and air separator

END OF SECTION
SECTION 23 21 16 – PIPING SPECIALTIES

1.1 GENERAL REQUIREMENTS

A. Strainers:

1. Place strainers upstream of all regulators, pumps, chillers, boilers, control equipment or any other equipment, which could be damaged or rendered inoperative due to foreign matter in the piping. Provide adequate access for removal.

2. Provide parallel strainers with isolation valves on primary piping systems where operation is critical and is intended to continue during servicing. Strainers shall then be cleaned through removable caps.

3. For critical systems, provide pressure gauges to indicate loading. Consider clear see-through duplex strainers or filters for critical applications.

4. Provide single strainers with isolation valves on secondary piping systems where operation can be interrupted. Provide blowdown valves with caps on single strainers.

B. Hydronic Piping Specialties:

1. Provide factory fabricated piping specialties 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 installer to comply with connections, within properly mate with pipe, tube, and equipment connections.

C. General Information - Gauges

1. Provide gauge cocks at all gauges for removal under operation.

2. Employ independent gauges with range twice the operating pressure across pumps, strainers, pressure reducing stations, etc.

3. Monitor all systems by the building automation system for On/Off, temperatures, and pressures.

1.2 QUALITY ASSURANCE

A. Codes and Standards:

1. FCI Compliance: Test and rate “Y” type strainers in accordance with FCI 73-1 “Pressure Rating Standard for “Y” Type Strainers”. Test and rate other type strainers in accordance with FCI 78-1 “Pressure Rating Standard for Pipeline Strainers other than “Y Type”.
2. ASME B31.9 “Building Services Piping” for materials, products, and installation.

3. Safety valves and pressure vessels shall bear the appropriate ASME label.

4. Fabricate and stamp air separators and compression tanks to comply with ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.


1.3 MANUFACTURERS

A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Air Vents (manual)
   a. Armstrong Machine Works
   b. Bell & Gossett, ITT; Fluid Handling Div
   d. Spirax Sarco

2. Pipe Escutcheons:
   c. Producers Specialty & Mfg. Corp.

3. Mechanical Sleeve Seal:
   a. Thunderline Corp.

4. Fire and Smoke Barrier Penetration Seal:
   a. Dow Corning
   b. Electrical Products Div./3M
   c. Flame Stop, Inc.

5. Diaphragm Type Expansion Tanks
   a. Amtrol, Inc.
   b. Watts.
   c. Bell and Gossett ITT; Fluid Handling Div.

6. Air Separators:
   a. Bell and Gossett ITT; Fluid Handling Div.
   b. Amtrol Inc.
c. Armstrong Pumps, Inc.
d. Spirax Sarco

7. Combination Pressure and Temperature Relief Valves:
   a. Amtrol, Inc.
   b. Bell and Gossett ITT; Fluid Handling Div.
   c. Watts Regulator Co
   d. Spirax Sarco

8. Low Pressure Strainers:
   a. Metraflex Co.
   b. Hoffman Specialty ITT; Fluid Handling Div.
   c. Watts Regulator Co.
   d. Spirax Sarco

9. Basket Strainers:
   a. R-P&C Valve
   b. Keckley
   c. Metraflex

10. Pressure Reducing Valves (Water Application):
    a. Amtrol, Inc. Taco, Inc.
    b. Keckley
    c. Armstrong

11. Pump Suction Diffusers:
    a. Amtrol, Inc.
    b. Armstrong Pumps, Inc.
    c. Bell & Gossett ITT; Fluid Handling Div.

12. Diverting Fittings:
    a. Armstrong Pumps, Inc.
    b. Bell & Gossett ITT; Fluid Handling Div.
    c. Victaulic Company of America

13. Dielectric Waterway Fittings:
    a. America
    b. Epco Sales, Inc.

14. Hydronic System Safety Relief Valve:
    a. Kunkle Valve Co., Inc.
    b. Watts Regulator Co.
c. Bell & Gossett ITT; Fluid Handling Div.

15. Pressure Regulating Valves (Steam Application):
   a. Spence (preferred)
   b. Hoffman Specialty ITT; Fluid Div.
   c. Armstrong.

1.4 MATERIALS, GENERAL

A. Air Vents (Manual):

1. Bronze body and nonferrous internal parts; 150 psig working pressure, 212 degree F operating temperature; screwdriver or coin operated type.

2. Float Type: Brass or semi-steel body, copper float, stainless steel valve and valve seat; suitable for system operation temperature and pressure. With isolating valve.

3. Washer Type: Brass with hydroscopic fiber discs, vent ports, adjustable cap for manual shut-off, and integral spring loaded ball check valve.

4. Provide valve or gauge cock for isolation and repair.

5. Pipe high point manual air vents to drain. Notify Project Manager in areas where the manual vents can not be piped to drain.

B. Pipe Escutcheons:

1. General: Provide 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, or ceilings; and pipe sleeve extension, if any. Furnish pipe escutcheons with nickel or chrome finish for occupied areas, prime paint finish for unoccupied areas.

2. Pipe Escutcheons for Moist Areas: For waterproof floors, and areas where water and condensation can be expected to accumulate, provide cast brass or sheet brass escutcheons, solid or split hinged.

3. Pipe Escutcheons for Oversized Holes: Provide sheet steel escutcheons, solid or split hinged.

C. Dielectric Protection:

1. General: Provide standard products recommended by manufacturer for use in service indicated, which effectively isolate ferrous from non-ferrous piping (electrical conductance), prevent galvanic action, and stop corrosion.

2. Use dielectric waterway fittings rather than dielectric unions
3. Installing full-port brass valves, with half-unions at the inlet and outlet, to connect steel to copper pipe is acceptable.

4. Dielectric protection fittings shall be installed in equipment rooms only.

D. Sleeves: Provide pipe sleeves of one of the following:

1. Galvanized sheet steel with lock seam joints for sleeves passing through non-load bearing or non fire rated walls and partitions. Minimum gauges as follows:
   a. Pipes 2-1/2 inch and smaller: 24 gauge.
   b. Pipes 3 inch to 6 inch: 22 gauge.
   c. Pipes over 6 inch: 20 gauge.

2. Schedule 40 galvanized steel pipe or cast iron pipe for sleeves passing through load bearing walls, concrete beams, fire-rated partitions, foundations, footings, and waterproof floors.

3. Insulated Pipe: Sleeves of sufficient internal diameter to install pipe and insulation and allow for free movement of pipe.

4. In finished areas where pipes are exposed, terminate sleeves flush with wall, partitions, and ceiling and extend 1 inches above finished floors.

5. Fire Protection Lines: Extend sleeves a minimum of 3 inches above finished floor.

E. Mechanical Sleeve Seals:

1. 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. Foundation walls only.

F. Fabricated Piping Specialties:

1. Drip Pans: Fabricated from corrosion resistant sheet metal with watertight joints, and with edges turned up 2-1/2 inch. Reinforce top, either by structural angles or by rolling top over 1/4-inch steel rod. Provide hole, gasket and flange at low point for watertight joint and 1-inch drain line connection.

G. Expansion Tanks:

1. Compression Tanks: Welded carbon steel rated for 125 psig working pressure, 375 degree F maximum operating temperatures. Provide with taps in bottom of
tank for tank fittings and taps in end of tank for gauge glass. Tested and labeled in accordance with ASME Pressure Vessel Code.

a. Air Control Tank Fittings: Cast iron body, copper-plated tube, brass vent tube plug, and stainless steel ball check.

b. Tank Drain Fitting: Brass Body, nonferrous internal parts. Fitting to admit air into compression tank drain water, and close off the system.

2. Diaphragm Type Tanks: Welded steel, rated for 125 psig working pressure, 375 degree maximum operating temperature, flexible diaphragm sealed into tank. Provide taps for pressure gauge, air charging fitting, and drain fitting. Provide with steel legs or saddles. Tested and labeled in accordance with ASME Pressure Vessel Code.

H. Air Separators:

1. In-line air separators: Cast iron for sizes 1-1/2 inch and smaller, welded steel for sizes 2 inch and larger; tested and labeled for minimum 125 psig working pressure and 350 degree F operating temperature. ASME constructed and labeled

2. Air Elimination Valve: Bronze, float operated, for 125 psig operating pressure.

I. Pressure Reducing Valves:

1. Diaphragm operated, cast iron or brass body valve, with low inlet pressure check valve, inlet strainer removable without system shut-down and non-corrosive valve seat and stem. Factory set at operating pressure and field adjustable.

J. Hydronic System Safety Relief Valves:

1. Diaphragm operated, cast iron or brass body, Teflon seat, stainless steel stem and springs, with low inlet pressure check valve, inlet strainer removable without system shut-down, ASME certified and labeled. Select valve to suit actual system pressure and BTU capacity. Set valve to relieve at 10 psi above operating pressure.


L. Dielectric waterway fittings: Threaded end connections installed to isolate dissimilar metals, prevent galvanic action, and prevent corrosion.

M. Automatic Air Vent:

1. Designed to vent automatically with float principle; bronze body and nonferrous internal parts; 150 psig working pressure, 240 degree F operating
temperature; and having 1/4 inch discharge connection and 1/2 inch inlet connection. B & G Model #87.

N. Pump Suction Diffusers:

1. Cast iron body, with threaded connections for 2 inch and smaller, flanged connections for 2-1/2 inch and larger; 175 psig working pressure, 300 degree F maximum operating temperature; and complete with the following features:
   a. Inlet vanes with length 2-1/2 times pump suction diameter or greater.
   b. Cylinder strainer with 3/16 inch diameter openings with total free area equal to or greater than 5 times cross-sectional area of pump suction, designed to withstand pressure differential equal to pump shutoff head.
   c. Disposable fine mesh strainer to fit over cylinder strainer.
   d. Permanent magnet located in flow stream, removable for cleaning.
   e. Adjustable foot support designed to carry weight of suction piping.
   f. Blowdown tapping in bottom; gauge tapping in side.

O. Diverting Fittings: Cast iron body with threaded ends or wrought copper with solder ends; 125 psig working pressure, 250 degree F maximum operating temperature. Indicate flow direction on fitting.

P. Low Pressure Y-Pattern Strainers:

1. Line size strainer with ends matching piping system materials, 125 psig working pressure with Type 304 stainless steel screens with 3/64-inch perforations at 233 per square inch.
   a. Threaded Ends, 2-Inch and Smaller: Cast iron body, screwed screen retainer with centered blowdown fitted with pipe plug.
   b. Threaded or Flanged Ends, 2-1/2-inch and Larger: Cast iron body, bolted screen retainer with off-center blowdown fitted with pipe plug.
   c. Butt Welded Ends, 2-1/2-inch and Larger: Schedule 40 cast carbon steel body, bolted screen retainer with off-center blowdown fitted with pipe plug.
   d. Grooved Ends, 2-1/2-inch and Larger: Tee pattern, ductile-iron or malleable-iron body, and access end cap, access coupling with EDPM gasket.

Q. High Pressure Pipeline Strainers:
1. Line size with ends matching piping system materials, 250 psig working pressure with Type 304 stainless steel screens with 3/64-inch perforations at 233 per square inch.

   a. Threaded Ends, 2-Inch and Smaller: Cast iron body, screwed screen retainer with centered blowdown fitted with pipe plug.

   b. Threaded or Flanged Ends, 2-1/2-inch and Larger: Cast iron body, bolted screen retainer with off-center blowdown fitted with pipe plug.

   c. Butt Welded Ends, 2-1/2-inch and Larger: Schedule 40 cast carbon steel body, bolted screen retainer with off-center blowdown fitted with pipe plug.

   d. 1/2-inch and Larger: Tee pattern, ductile-iron or malleable-iron body, and access end cap, access coupling with EDPM gasket.

R. Basket Strainers:

   1. For 125 psig Systems or less and pipe sizes 16-inches or less: High-tensile ASTM A126B Class B cast iron, angle design, ductile iron clamped cover, flanged ends, stainless steel screen assembly, suitable gasket material, bottom threaded drain outlet.

   2. For systems operating greater than 125 psig and pipe sizes greater than 16-inches: High-tensile ASTM A126 Class B cast iron, angle design, bolted cover, flanged ends, stainless steel screen assembly, suitable gasket material, bottom threaded drain outlet.

S. Gas Meter:

   1. As per local utility supplier.

   2. Coordinate any monitoring of meter with 23 09 00.

T. Domestic Water Meter:

   1. General: Install per local utility.

U. Vacuum Breakers

   1. Armstrong
   2. Watts
   3. Hoffman+
   4. Spirax Sarco

1.5 INSTALLATION, GENERAL

A. General:
1. Install specialties in accordance with manufacturer’s instructions to provide intended performance.

2. Support tanks inside building from building structure in accordance with manufacturer’s instructions.

3. Where large air quantities can accumulate, provide enlarged air collection standpipes.

4. For automatic air vents in ceiling spaces or other concealed locations, provide vent tubing to nearest drain.

5. Provide manual air vents at system high points and as indicated with ¼” X 2” minimum copper tube to direct flow of air and fluid.

6. Provide valved drain and hose connection on strainer blow down connection.

7. Support pump fittings with floor mounted pipe and flange supports.

8. Provide relief valves on pressure tanks, low pressure side or reducing valves, heat exchangers, and expansion tanks.

9. Select system relief valve capacity so that it is greater than make-up pressure reducing valve capacity.

10. Pipe relief valve outlet to nearest floor drain.

11. Where one line vents several relief valves, make cross sectional area equal to sum of individual vent areas.

12. 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 sleeve but not to insulation with set screws. Install escutcheon to cover penetration hole and flush with adjoining surface. Provide high cap type escutcheon to clear sleeve extension where sleeve extends above finished surface.


14. Mechanical Sleeve Seals: at exterior foundation walls only
   a. Installed between sleeve and pipe.
   b. Loosely assemble rubber links around pipe with bolts and pressure plates located under each bolt head and nut. Push into sleeve and center. Tighten bolts until links have expanded to form watertight seal.

B. Hydronic Specialties Installation:
1. Install automatic air vents where noted.

2. Install in-line air separators in pump suction lines. Run piping to compression tank with 1/4 inch per foot (2%) upward slope towards tank. Install drain valve on units 2 inch and larger.

3. Install ball valve to isolate expansion tank for cleaning and blowdown. Install drain valve on tank for cleaning/blowdown.

4. Install separator in pump suction lines. Run piping to compression tank with 1/4 inch per foot (2%) upward slope towards tank. Install blowdown piping with ball valve, extend to nearest drain.

5. Provide sufficient number of pipe diameters to inlet of each pump as noted in detail or install pump suction diffusers on pump suction inlet, adjust foot support to carry weight of suction piping. Install nipple and ball valve in blowdown connection.

6. Install gauge glass and cocks on end of compression tanks. Install tank fitting in tank bottom and charge tank. Use manual vent for initial fill to establish proper water level in tank.

7. Provide adequate support from structure to carry twice the weight of the tank, piping connections, fittings, and weight of water assuming a full tank of water. Do not overload building components and structural members. Coordinate concrete inserts with general contractor.

END OF SECTION
1.1 GENERAL REQUIREMENTS

A. This specification includes flushing, cleaning, and treating the following systems:

1. Flushing, Cleaning, and Treating of water filled systems that interface with the CUP
2. Flushing, Cleaning, and Treating of water filled systems that do not interface with the CUP
3. Steam and condensate systems
4. Pre-cleaning and passivation of condenser water and cooling tower systems

B. Flushing, Cleaning, and Treating of Systems into the university Distribution System(s).

1. It is the contractor’s responsibility to ensure that the system(s) is clean, and has been properly treated. It is the university Water Treatment contractor’s responsibility to verify that the system(s) has been properly treated and is ready to be opened into the university Distribution System(s).

2. Co-ordinate with the university CUP personnel and the current university CUP Water Treatment contractor to determine which tests and inspections will be monitored.

3. Contact the university Outage Coordinator to schedule the opening of any/all system(s) into the same university system(s). The university Outage Coordinator must have all required paperwork on file before they will schedule a system startup.
1.2 EXECUTION

A. Chilled Water and Heating Water Systems

1. Chilled water piping must be pre-cleaned and passivated prior to operation. To accomplish this, a method must be provided to circulate these lines at design flow during cleaning. Design minimum flows are stated as a function of pipe diameter in the table below:

<table>
<thead>
<tr>
<th>Pipe Diameter in Inches</th>
<th>Cross Sectional Area in Feet</th>
<th>Min. GPM for 2 ft/sec Velocity</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>0.2</td>
<td>180</td>
</tr>
<tr>
<td>8</td>
<td>0.35</td>
<td>314</td>
</tr>
<tr>
<td>12</td>
<td>0.79</td>
<td>708</td>
</tr>
<tr>
<td>16</td>
<td>1.4</td>
<td>1,256</td>
</tr>
<tr>
<td>24</td>
<td>3.14</td>
<td>2,818</td>
</tr>
<tr>
<td>36</td>
<td>7.06</td>
<td>6,284</td>
</tr>
</tbody>
</table>

2. Taps will be installed, in the vault, on the building side of the supply and return isolation valves. The building pump or temporary circulation pump will circulate the water during the pretreatment process.

3. The addition of Isothiazolin biocide is required. It needs to be added after the system cleaning has been accepted. The nitrite must be added 24 hours after the nitrite has been added.

4. During the flushing, cleaning, and treating process, insure that the minimum flow of 2 feet/second is met. Flow less than 2 feet/second is not acceptable. Flows greater than 2 feet/second, up to the maximum design flow of the system, are acceptable and will assist in the flushing, cleaning, and treating process. Maximum flow is preferred but not required.

5. If possible, on heating water systems, heat the bulk water to 120 degrees F during the circulation period.

6. The university CUP must approve all products that will be used prior to the start of the process. Only factory blended products will be considered. Products blended onsite are not allowed.

7. Biological samples can only be taken Monday through Thursday (Holidays excepted). The sample is sent overnight to the lab. Until the test results return acceptable, a system will not be allowed to be opened into the existing university Distribution system.

8. Two options exist for pre-cleaning. One approach is an alkaline based approach and the other is a nitrite based approach. Consult the university CUP prior to choosing an approach. The alkaline based pre-cleaner applies a minimum of 500 ppm of total inorganic phosphate within the treated water. The pre-cleaner should also contain detergents and dispersants designed to perform an effective cleaning at pH values of 11.5 or higher. The pretreatment plan should also
include a minimum of 10 ppm of organic copper corrosion inhibitor such as “TT” in the bulk water. An alternative nitrite based approach uses nitrite, detergents, dispersants and 10 ppm of organic copper corrosion inhibitor such as “TT”. This product is applied to achieve nitrite residuals of in excess of 600 ppm as NO2. These treatment levels can be achieved by adding 2.5 gallons of Nalco-2859, or an equivalent product, to the system per 1000 gallons of system capacity.

a. Flushing, Cleaning, and treating Chilled Water and Heating Water systems using an Alkaline Based Cleaner. Remember that the timeline below is dependent upon all things occurring as they are written. The timeline below is bare bones for an average sized system. Smaller projects may be able to save some time during the filling and draining periods.

1) Day 1: Fill the entire system that is available with city water and continuously circulate the water with one of the system pumps throughout the building, through all chilled water lines, including lines to vaults. If there is more than one pump in the system, alternate the pumps at least once during this process to ensure each pump is run.

2) Day 2 (24 hours after step #1): The university CUP and/or the university Water Treatment contractor, the contactors water treatment vendor, and the contractor to test the water for conductivity and view the water for clarity. If there are no issues, the university CUP will give a verbal “OK” to the contractor onsite to proceed with the drain down. This “OK” will be followed up with an e-mail to all interested parties.

3) Day 3: Refill the entire system that is available with city water and add the approved alkaline based cleaner. Your water treatment consultant will need to calculate the correct amount of cleaner needed. Circulate the water with one of the system pumps throughout the building, through all chilled water lines, including lines to vaults. If there is more than one pump in the system, alternate the pumps at least once during this process to ensure each pump is run. Run each pump at least two separate times.

4) Day 4: Continue to circulate the entire system with the cleaner in it throughout the building, including lines to vaults (If required). If there is more than one pump in the system, alternate the pumps at least once during this process to ensure each pump is run. We would like to see each pump to run two separate times.

5) Day 5 (A minimum of 48 hours after step #3 has been completed): The university CUP and/or the university Water Treatment contractor, the contactors water treatment vendor, and the contractor to test water for pH and conductivity. If the Ph test is above 11.5 and the conductivity is elevated well above city water
conductivity, a verbal “OK” will be given that the pH of the water is acceptable and the drain down and flushing out of the cleaner can start. This “OK” will be followed up with an e-mail to all interested parties.

6) Day 6: If the following does not occur as written, all dates below this will be affected. When the conductivity is within 10% of the conductivity of the City of Aurora water, contact the university CUP. The university CUP will meet with the contactors water treatment vendor and the contractor at the site and test the water for conductivity and pH. If the conductivity test is within 10% of the conductivity of the City of Aurora water, a verbal “OK” will be given that it is acceptable to add the Isothiazolin biocide. Circulate the system for 24 hours and then proceed to step #7. This “OK” will be followed up with an e-mail to all interested parties.

7) Day 7 (24 hours after step #6 has been completed): Add enough of the approved inhibitor (Nitrite) to raise the level of nitrite in the system to a minimum of 600 ppm. Your water treatment consultant will need to calculate the correct amount of chemical needed.

8) Day 9 (A minimum of 48 hours after step #7 has been completed): Contact the university CUP. The university CUP and/or the university Water Treatment contractor will meet with the contactors water treatment vendor and the contractor at the site and test the water for conductivity and nitrite, and a biological sample will be taken and sent overnight to the lab. If the nitrite is at 600 ppm or higher and the conductivity is elevated, a verbal OK of the nitrite level will be given. If the nitrite level is low, a verbal denial will be given and more nitrite will need to be added. Conductivity will be tested to verify that the conductivity is elevated above city water conductivity. A sample for biological testing will be taken and sent overnight to the university Water Treatment contractors testing lab. We encourage you to have you water treatment consultant to have biological testing performed on the water. Ensure that the lab that performs the testing will test for aerobic, anaerobics and denitrifying bacteria.

9) Keep the system flowing until it is opened up to the university Chilled Water Distribution system.

10) When the test results become available, we will share them with all interested parties. If the sample passes the biological tests, proceed to the next step. If the sample fails one or more of the tests, we will need to met as a group and discuss recleaning and re-treating of the system.
11) Once the system has successfully passed all tests, schedule with university Outage Coordinator to open the system up to the university Chilled Water Distribution system.

b. Flushing, Cleaning, and treating Chilled Water and Heating Water systems using a Nitrite Based Cleaner. Remember that the timeline below is dependent upon all things occurring as they are written. The time line below is bare bones for an average sized system. Smaller projects may be able to save some time during the filling and draining periods.

1) Day 1: Fill the entire system that is available with city water and continuously circulate the water with one of the system pumps throughout the building, through all chilled water lines, including lines to vaults. If there is more than one pump in the system, alternate the pumps at least once during this process to ensure each pump is run.

2) Day 2 (24 hours after step #1): The university CUP and/or the university Water Treatment contractor, the contactors water treatment vendor, and the contractor to test the water for conductivity and view the water for clarity. If there are no issues, the university CUP will give a verbal “OK” to the contractor onsite to proceed with the drain down. This “OK” will be followed up with an e-mail to all interested parties.

3) Day 3: Refill the entire system that is available with city water and add the approved nitrite based cleaner. Circulate the water with one of the system pumps throughout the building, through all chilled water lines, including lines to vaults. If there is more than one pump in the system, alternate the pumps at least once during this process to ensure each pump is run. Run each pump two separate times.

4) Day 4: Continue to circulate the entire system with the cleaner in it throughout the building, including lines to vaults (If required). If there is more than one pump in the system, alternate the pumps at least once during this process to ensure each pump is run. We would like to see each pump to run two separate times.

5) Day 5 (A minimum of 48 hours after step #3 has been completed): The university CUP and/or the university Water Treatment contractor, the contactors water treatment vendor, and the contractor to test water for nitrite and conductivity. If the nitrite test is above 600 ppm and the conductivity is elevated above city water conductivity, a verbal “OK” will be given that the nitrite level in the water is acceptable and the bleed/fill of the nitrite based cleaner can start. With the pump still running, open a ¾” drain to a sanitary sewer and start to purge water from the system. At the same time add water to the system to replace the water that
is being purged down the drain. Continue to do this until the nitrite level is down to 200 to 300 ppm. 300 ppm is preferred. DO NOT do this bleed/fill if there is nobody to monitor the process. This “OK” will be followed up with an e-mail to all interested parties.

6) Day 6: If the following does not occur as written, all dates below this will be affected. When the nitrite level in the water is between 200 and 300 ppm, contact the university CUP. The university CUP will meet with the contactors water treatment vendor and the contractor at the site and test the water for conductivity and nitrite. If the nitrite is between 200 to 300 ppm, a verbal “OK” will be given that it is acceptable to add the isothiazolin biocide. Circulate the system for 24 hours and then proceed to step #7. This “OK” will be followed up with an e-mail to all interested parties.

7) Day 7 (24 hours after step #6 has been completed): Add enough of the approved inhibitor (Nitrite) to raise the level of nitrite in the system to a minimum of 600 ppm. Your water treatment consultant will need to calculate the correct amount of chemical needed.

8) Day 9 (A minimum of 48 hours after step #7 has been completed): Contact the university CUP and/or the university Water Treatment contractor. The university CUP will meet with the contactors water treatment vendor and the contractor at the site and test the water for conductivity and nitrite, and a biological sample will be taken and sent overnight to the lab. If the nitrite is at 600 ppm or higher and the conductivity is elevated, a verbal OK of the nitrite level will be given. If the nitrite level is low, a verbal denial will be given and more nitrite will need to be added. Conductivity will be tested to verify that the conductivity is elevated above city water conductivity. A sample for biological testing will be taken and sent overnight to the university Water Treatment contractors testing lab. We encourage you to have your water treatment consultant to have biological testing performed on the water. Ensure that the lab that performs the testing will test for aerobic, anaerobics and denitrifying bacteria.

9) Keep the system flowing until it is opened up to the university Chilled Water Distribution system.

10) When the test results become available, we will share them with all interested parties. If the sample passes the biological tests, proceed to the next step. If the sample fails one or more of the tests, we will need to meet as a group and discuss re-cleaning and re-treating of the system.

11) Once the system has successfully passed all tests, schedule with the University Outage Coordinator to open the system up to the university Chilled Water Distribution system.
B. Steam and condensate systems

1. Steam lines do not need to be cleaned or passivated prior to being put in-service since steam is oxygen free, and produces a non-corrosive environment. Steam blows on steam mains that are six inches in diameter or larger are required. A steam blow involves performing a series of cyclic brief venting of steam to atmosphere. The objective is to purge loose particulate material from the steam lines. Remove all strainer screens and check for debris. Clean the screens before reinstalling them. The university CUP Operations staff and/or the university Water Treatment contractor will be present to inspect a limited number of screens. Once this is accomplished the steam line may be put into service.

2. The condensate receivers will need to be initially “dumped” down the drain during the first few days of operation. Add tempering water as need to ensure that the condensate going down the drain is less than 160 F. If possible inspect the receiver for evidence of oil or organic contamination prior to putting the receiver in service. In the unlikely event that oil or organic material has contaminated the condensate receiver contact the CUP for consultation. System cleaning would be required prior to interfacing with the bulk condensate system.

3. Once the conductivity of the condensate is less than 20 and the hardness is 0.5 ppm or less, the condensate can be opened into the university Condensate System.

C. Pre-cleaning and passivation of condenser water and cooling tower systems

1. To perform an effective system cleaning and passivation, a phosphate prep is recommended. The use of N-2578 or an equivalent phosphate based cleaner is suggested to perform the procedure. N-2578 is a blend of inorganic phosphate, detergent, dispersants and organic copper corrosion inhibitors. Sufficient product should be added to the system to boost total inorganic phosphate residuals to a level in excess of 500 ppm as PO4. It is important to maintain good biological control during the passivation process. The use of an oxidizing biocide such as bromine or chlorine is not recommended since it will interfere with the passivation process. The use of a nonoxidizing biocide at a heavy dose is recommended during the passivation.

2. For most effective results, system pH must be maintained in the 7.0-7.5 range, targeting 7.25. The procedure will still work with pH as high as 8.0. If system pH rises to 8.5 the pH should be lowered by gradually adding dilute sulfuric acid. Add acid very slowly and check the pH every 30 minutes. When adding acid, gradually lower the pH into the 7.0-7.5 range, targeting 7.25. If pH goes down to 6.5, gradually add soda ash in a slurry form to raise pH into the 7.0-7.5 range, targeting 7.25.

3. DO NOT OPERATE CHILLERS IN THIS SYSTEM DURING THE CLEANING PROCEDURE.
4. When the PH of the system has been stabilized between 7.0 and 7.5, circulate the treated system at design flows through the entire system for a minimum of 8 hours. Purge all strainers in the system every hour during the pre-cleaning process. After 8 hours of circulation, shutdown the pump(s) and drain the entire system.

5. Fill and flush the entire system with city water until the flush water is clear and free of particulate material. Refill the system with city water. Perform cleaning method as follows:
   a. Add a 300 ppm dose of N-2593 biocide or an equivalent to the system while circulating. N-2593 is an isothiazolin based biocide
   b. Gradually add N-2578 to the system. Recommended dose is 2.5 gallons per 1000 gallons of system capacity. Check system pH and insure the concentration is in the range stated above. Contact the university Water Treatment contractor to confirm total inorganic phosphate levels are above 500 ppm
   c. Continue to circulate for 24-48 hours with the system off-line and all legs of the system circulating. Check system pH once every 12 hours. Add anti-foam N-7465 as needed
   d. When the cleaning is complete, drain the system several times until system conductivity is within 200 microsiemens of city water. Contact the university Chemical contractor to confirm total inorganic phosphate levels are below 10 ppm. If the phosphate level remains high, continue to drain and flush. Remove all strainer screens and check for debris. Clean the screens before reinstalling them. The university CUP Operations staff and/or the university Water Treatment contractor will be present to inspect a limited number of screens.
   e. The system is now ready for normal operation with a properly run chemical treatment program. It is critical bulk water alkalinity is maintained in the 300-400 ppm range, targeting 350 ppm, in the early phases of operation. If sufficient load is not available to concentrate alkalinity we may artificially boost alkalinity into the recommended range by adding soda ash to the system.

6. Recommended ongoing treatment is using N-23208 phosphonate inhibitor, application of N-2593 isothiazolin based biocide at a 150 ppm dose weekly and the use of N-ST-20 bromine based biocide fed daily.

D. An equivalent chemical may be used after it has been approved for compatibility by the university. The contractor’s chemical vendor will provide data sheets to the university with the request for approval for an equivalent chemical. Equivalent chemicals cannot be used until they have been approved by the university.
SECTION 23 30 00 - HVAC AIR DISTRIBUTION

1.1 GENERAL

A. Insulated flexduct shall not be used for this project.

B. Provide spin-in fittings with locking damper bearings at all flexible or round sheet metal duct take-offs.

C. Flex duct shall not be used for laboratory projects.

D. Provide spin-in fittings with locking damper bearings at all flexible or round sheet metal duct take-offs.

E. Utilize stainless steel ducts for laboratory exhaust systems.

F. Utilize galvanized steel ducts for laboratory supply systems.

1.2 SUBMITTALS:

A. Submit 1/4 inch scaled fabrication and layout drawings of metal ductwork and fittings including, but not limited to, duct sizes, locations, elevations, and slopes of horizontal runs, wall and floor penetrations, and connections. Show interface and spatial relationship between ductwork and proximate equipment. Show modifications of indicated requirements, made to conform to local shop practice, and how those modifications ensure that the area materials and rigidity are not reduced.

B. Submit diffuser, register, and grille performance characteristics including, cfm ratings, pressure drops, nc levels, and throw patterns.

C. Submit louver color samples for selection and approval.

D. Submit duct access door coordination drawing for approval.

1.3 QUALITY ASSURANCE:

A. Comply with SMACNA’s “HVAC duct construction standards, second edition” and SMACNA’s “HVAC air duct leakage test manual”.

B. ASHRAE standards: comply with ASHRAE systems and equipment handbook.

C. NFPA compliance: comply with NFPA 90a “standard for the installation of air conditioning and ventilating systems” and NFPA 90b “standard for the installation of warm air heating and air conditioning systems”.

D. Filter media shall be ANSI/UL 900 listed, class 1 or class 2, as approved by local authorities.
E. Air terminals shall comply with ARI 880, “industry standard for air terminals” and shall bear the ARI certification seal.

1.4 MANUFACTURERS:

Acceptable manufacturers: subject to compliance with requirements, provide products by the following:

A. Flexible duct:
   1. Flex-master
   2. Thermaflex
   3. Hercules

B. Balance dampers:
   1. Greenheck
   2. Ruskin
   3. Pottorff

C. Ductwork
   1. Hercules
   2. Shop fabricated.

D. Air terminal units:
   1. Siemens building technologies

E. Grilles, registers and diffusers:
   1. Metalaire
   2. Titus
   3. Price
   4. Nailor

1.5 MATERIALS, GENERAL

A. Ductwork:
   1. Galvanized ducts: lock-forming quality, ASTM A527, coating designation G90. Provide mill phosphatized finish for exposed surfaces of ducts exposed to view. Provide flat seam construction where standing seams are a hazard to the university operating personnel.

3. Stainless steel ducts: ASTM A480 type 316 with no. 4 finish on surfaces of ducts exposed to view; type 304 with no. 1 finish for concealed ducts. Protect finished surfaces with mill applied adhesive protective paper, maintained through fabrication and installation.

4. Sealant: UL listed, class 1, flame spread 0, fuel contributed 0, smoke developed 0, water based sealer.

5. Flexible duct: comply with UL 181, class 1.
   a. Uninsulated: spiral-wound galvanized steel helix, mechanically locked to fiber glass cloth fabric.
   b. Insulated: inner core of one ply corrugated aluminum duct, 1-inch thick, ¾ pound insulation and aluminized vapor barrier.

6. Accessories:
   a. Turning vanes: multi-blade device with blades aligned in short dimension; steel or aluminum construction; with individually adjustable blades and mounting straps.
   b. Duct access doors:
      1) Fabricate in accordance with SMACNA low pressure duct construction standards and as indicated.
      2) Fabricate rigid and close fitting doors of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, install minimum one inch thick insulation with sheet metal cover.
      3) Access doors smaller than twelve inches square may be secured with sash locks.
      4) Provide two hinges and two sash locks for sizes up to 18 inches square, three hinges and two compression latches with outside and inside handles for sizes up to 24 x 48 inches. Provide an additional hinge for larger sizes.
      5) Access doors with sheet metal screw fasteners are not acceptable.

B. Dampers:
   1. Backdraft dampers: parallel blades, gravity balanced backdraft dampers shall be made of 16 gauge galvanized steel. Provide center pivoted blades of maximum six inch width, with flexible vinyl sealed edges, linked together in a rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin, and adjustment device to permit setting for varying differential static pressure.
   2. Low pressure manual dampers: single or multi-blade type with position-indicating device and lock.
   3. Fire dampers: fabricated in accordance with NFPA 90a and ul555. Fabricate curtain type dampers of galvanized steel with interlocking blades. Provide...
stainless steel closure springs and latches for horizontal installations. Configure with blades out of air stream except for low pressure ducts up to 12 inches in height. Fabricate multiple blade fire dampers with 16 gauge galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, 1/8 x 1/2 inch plated steel concealed linkage, stainless steel closure spring, blade stops and lock. Fusible links, ul 33, shall separate at 160 degrees f. Provide adjustable link straps for combination fire/balancing dampers

4. Combination fire smoke dampers: fabricated in accordance with NFPA 90a, 92a, 92b, and ul standards 555 and 555s. Dampers shall have a ul555 fire rating of xxx

5. Each damper shall be equipped with a heat responsive device which has been tested and approved for use with the damper assembly in accordance with ul555. The heat responsive device shall have a temperature rating of 165 f or 212 f. Dampers shall be ul labeled for use in dynamic systems. The damper shall have a dynamic closure airflow rating equal to or greater than the airflow at the damper's installed location and a dynamic closure pressure rating of 4 in wg.
   a. Dampers shall have a ul555s leakage rating of class ii and a temperature rating of 350 f. Dampers shall have a ul555s operational airflow rating equal to or greater than the airflow at its installed location and an operational pressure rating of 4 in wg. Damper actuators shall be factory mounted and qualified for use with the damper in accordance with ul555s. Damper actuators shall be electric type for 120, 24 volt operation or pneumatic type for 20 psi minimum operation.
   b. The damper manufacturer's submittal data shall certify all air performance pressure drop data is licensed in accordance with the AMCA certified ratings program for test figures 5.2, 5.3 and 5.5. Damper air performance data shall be developed in accordance with the latest edition of AMCA standard 500-d.
   c. Damper blades shall be 16 ga galvanized steel 3 vee type with three longitudinal grooves for reinforcement. Blades shall be completely symmetrical relative to their axle pivot point, presenting identical resistance to airflow and operation in either direction through the damper (blades that are non-symmetrical relative to their axle pivot point or utilize blade stops larger than 0.5 in are unacceptable).
   d. Damper frames shall be galvanized steel formed into a structural hat channel shape with reinforced corners. Bearings shall be sintered bronze sleeve type rotating in extruded holes in the damper frame. Jamb seals shall be stainless steel compression type.

6. Spare parts: refer to section 01 78 46 – extra stock materials.

C. Filters:
   1. Disposable Pre-filters (MERV 8):
      a. Media: 4 inch thick, fiber blanket, factory sprayed with flameproof, non-drip, non-volatile adhesive. 20 gauge galvanized steel holding frame.
Nominal size 24 inches by 24 inches. Pre-filters shall have slide-in frames, which shall be sealed to prevent bypass.

b. Rating: 500 FPM face velocity, 0.15 inches w.g. initial resistance, 0.5 inches w.g. final resistance.

2. Extended Surface Retained Media Filters (MERV 11):
   a. Media: Pleated, non-woven cotton fabric, scrim reinforced. 16 gauge galvanized steel holding frame with corrosion resistant coating. Effective media area of 50 square feet per 1000 CFM. Nominal size 24 inches by 24 inches by 12 inches deep.
   b. Rating: ASHRAE 52; 60 percent dust spot efficiency, 96 percent average weight arrestance. 500 FPM face velocity, 0.5 inches w.g. initial resistance, 1.2 inches w.g. final resistance.

3. Extended Surface High Efficiency Media Filters (MERV 14):
   a. Media: Pleated, water resistant glass fiber with aluminum or kraft separators. 16 gauge galvanized steel holding frame with corrosion resistant coating. Effective media area of 50 square feet per 1000 CFM. Nominal size 24 inches by 24 inches by 12 inches deep.
   b. Rating: ASHRAE 52; 95 percent dust spot efficiency. 500 FPM face velocity, 0.65 inches w.g. initial resistance, 1.0 inches w.g. final resistance.

D. Air terminals:

1. General: air terminals shall not exceed sound ratings as scheduled in accordance with AMCA 301 and tested according to AMCA 300.

2. Laboratory room exhaust terminal:
   a. Casing: minimum 22 gauge galvanized steel with welded seam.
   b. Damper: 22 gauge galvanized steel single blade damper with stainless steel fasteners and 1/2" 316 stainless steel damper shaft.
   c. Airflow sensor: square edge plate with averaging pressure taps.
   d. Damper bushing: Teflon
   e. Accuracy: +/- 2% of actual flow at listed ranges.
   f. Reliability: +/- 15%.
   g. Airflow control: round, non-sealing single blade damper with 90 degree control.
   h. Equivalent to laboratory room exhaust terminals in similar procedure rooms on the floor being renovated.

E. Grilles, registers, and diffusers:

1. General:
   a. Test and rate performance in accordance with 230593, ARI 880 and ASHRAE 70.
   b. Coordinate borders and mounting frames with ceiling and wall finish.
   c. Provide airflow capacity and throw patterns as shown. Pressure drops of diffusers and supply registers shall not exceed 0.1 inch w.g. and pressure drops for return and exhaust grilles shall not exceed 0.05 inch w.g. unless otherwise shown.
d. Dampers shall be opposed blade type; key or standard blade screwdriver operated from the face of the unit.
e. Provide opposed blade damper keys.

2. Diffusers:
   a. Louvered face: square, louvered face steel diffuser with movable blades accessible from face for adjustable discharge and volume damper. Border style compatible with ceiling system. Finish shall be white. Face size shall equal ceiling module size when mounted in ceiling grid; i.e., a diffuser with 24-inch x 24-inch face would be provided for a 24 x 48 ceiling grid.
   b. Linear bar diffuser with deflection bars fixed and parallel to long dimension with opposed blade damper. Finish shall be white. Provide alignment strips to join sections together end-to-end for continuous appearance.
   c. Slot: aluminum linear slot diffuser with direction and volume adjustable by 180 degree controller. Number of slots shall be as shown. Finish shall be white. Diffuser shall be capable of being joined end-to-end for continuous appearance. Provide steel blank-offs, alignment pins, end caps, and borders.
   d. Round: round diffuser constructed of 18 gauge steel with four round cones and round inlet neck. Field adjustable airflow discharge pattern from horizontal to vertical. Finish shall be white. Provide with round steel damper and safety chain.

3. Registers:
   a. Supply register: double deflection, 3/4-inch blade spacing, 1-1/4-inch steel border with extruded aluminum airfoil blades and steel opposed blade damper. Front blades parallel to long dimension. Blades individually adjustable and securely held in place. Provide gasket between the frame and surface. Register finish shall be white.

4. Grilles:
   a. Perforated steel ceiling grille with 3/16-inch diameter holes on 1/4-inch staggered centers. Finish shall be white.
   b. Wall grilles: 45-degree deflection, 3/4-inch blade spacing, steel grille with front blades parallel to long dimension. Grille finish shall be white.

1.6 INSTALLATION, GENERAL

A. Accessories:
   1. Install access doors of sufficient size at all fire damper, filter, or coil location to provide for cleaning and inspection.
   2. Where fire dampers are installed, paint duct red at damper.
3. Provide tight fitting access doors sealed with gaskets for inspection and replacement of fusible links. Doors shall be installed, so access is unobstructed. Where these doors occur on concealed ducts, provide access doors in walls or ceiling properly aligned to permit the servicing of the fusible links. Mark ceiling or walls according to accepted identification.

B. Ductwork:

1. Maximum flexible ductwork length shall be 6 feet. Secure flexible ductwork to collars with metal bands. Support at least every 3 feet.

2. General: install each run with minimum number of joints. Align ductwork accurately at connections, within 1/8-inch misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with suitable ties, braces, hangers and anchors of type that will hold ducts true to shape and to prevent buckling, popping or compressing. Support vertical ducts at every floor.

3. Construct ductwork to the following pressure calculations:
   a. Lab exhaust ductwork: 2 inch wg negative static pressure.
   b. Medium pressure supply ductwork: 2 inch wg positive static pressure
   c. Low pressure supply ductwork: 1 inch wg positive pressure
   d. Supply ductwork serving biological safety cabinets (high and low pressure): 2 inch wg positive static pressure.

4. Inserts: install concrete inserts for support of ductwork in coordination with form work, as required to avoid delays in work.

5. Field fabrication: complete fabrication of work at project as necessary to match shop fabricated work and accommodate installation requirements.

6. Routing: run ductwork in shortest route that does not obstruct useable space or lock access for servicing building and its equipment. Hold ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of the building. Limit clearance to 1/2 inch where during is shown for enclosure or concealment of ducts, but allow for insulation thickness. Locate insulated ductwork for 1 inch clearance outside of insulation. In finished and occupied spaces, conceal ductwork from view, by locating in mechanical shafts, hollow wall construction or above suspended ceilings, do not encase horizontal runs in solid partitions, except as specifically shown. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.


8. Transitions: diverging transitions shall not exceed 15 degrees per side. Converging transitions shall not exceed 30 degrees per side.

9. Elbows: use radius elbows with throat radius equal to duct depth wherever possible.
10. Flexible duct fan connections: install flexible duct with at least one inch slack to insure that no vibration is transmitted from fan to ductwork.

11. Penetrations: where ducts pass through interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same gage as the duct. Overlap opening on all four sides by at least 1-1/2 inch. Fasten to duct only.

12. Coordination: coordinate duct installations with installation of accessories, dampers, coil frames, equipment controls and other associated work of ductwork system.

13. Temporary closure: at ends of ducts which are not connected to equipment or air distribution devices at the time of the 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.

C. Sealing of ducts:

1. General:
   a. All ducts, seams, and joints (lateral and horizontal) shall be sealed with sealant.
   b. Metal surfaces to be joined shall be clean, dry, and grease free.
   c. Apply a heavy brush coat of sealant to the interior metal surface of the duct slip joint, then interlock securely the duct sections and position into place.
   d. Apply a heavy brush coat finish of sealant to the exterior metal surface duct joint or seam covering heads of lock joint screws. Ensure that all voids are completely filled to provide a continuous air pressure seal.
   e. Where ducts are subject to excessive vibration or mechanical abuse, the exterior joint finish shall consist of a heavy coat of brush applied sealant reinforced with 2-inch wide glass fabric. Press the reinforcing fabric into the wet sealant and cover with a second coat of brush applied sealant.

2. Low pressure ducts: seal in accordance with SMACNA standards for class b seals.

3. Medium and high pressure ducts: seal in accordance with SMACNA standards for class a seals.

D. Grilles, registers, and diffuser installation:

1. In moist areas, install grilles, registers, and diffuser with stainless steel or aluminum fasteners.

2. When installing grilles, registers, and diffusers in existing drop ceilings provide additional t-sections as required for a finished opening for the grille, register, or diffuser.
3. All grilles and diffusers mounted in hard ceiling, must be set in frame and be removable to limit the use of access doors

E. Access panels:

1. Install access panels for inspection, maintenance, and cleaning of all automatic dampers, fire and smoke dampers, duct turning vanes, before and after all coils, and at other locations where equipment will require service.

2. Access panels to fire dampers shall be labeled with letters not less than 1/2-inch in height reading "fire damper." for locations where access panels are insulated, provide identifying labels on the exterior of the insulation.

1.7 TESTING, CLEANING, AND CERTIFICATION

A. Air cleaning devices: systems shall not be operated during construction.

B. Leakage tests: conduct duct leakage test in accordance with SMACNA HVAC air duct leakage test manual. Repair leaks and repeat tests until total leakage is less than the maximum permissible leakage as specified below.

C. General:

1. Ductwork pressure tests shall be observed by architect/engineer prior to installation of insulation.

2. Ductwork systems in the three-inch w.g. pressure class and higher shall be tested in their entirety for leaks. Arbitrary sections of ductwork in the two inch w.g. and lower pressure class shall be tested as required by the engineer.

D. All tests shall be witnessed by the university’s representative and approved by architect/engineer and the university representative, coordinated through the project manager.

END OF SECTION
PART 1 - GENERAL

1.1 WORK INCLUDED:

A. Water cooled chillers.
B. Controls and control panel.
C. Manufacturers shall be responsible to provide any information to the contractor prior to bidding which may impact the installed cost for the contractor including but not limited to:
   1. Power wiring sizing quantity and type of conductors.
   2. Control power.
   3. Auxiliary piping connections.

1.2 BIDDING REQUIREMENTS:

A. Proposal shall include fabrication and delivery schedule.
B. If disassembling and reassembly is required, that cost shall be a part of this bid.

1.3 REFERENCES AND REGULATORY REQUIREMENTS:

C. ASME Section VIII - Boiler and Pressure Vessel Code.
D. ANSI/UL 465 - Central Cooling Air Conditioners.
E. AHRI Standard 550/590-98 - Provide UL label. Centrifugal or Rotary Water Chilling Packages.

1.4 SUBMITTALS:

A. Submit product data, shop drawings, and wiring diagrams in accordance with Section 23 05 00.

1.5 DELIVERY, STORAGE, AND HANDLING:

A. Deliver chillers as a complete factory-assembled unit with protective crating and covering.
B. Comply with manufacturer’s installation instructions for rigging, unloading, and transporting unit.
C. Store, on site, in a dry/clean environment. Protect chiller(s) from physical damage. Leave factory shipping covers in place until installation is complete.
D. Additional Refrigerant: Coordinate delivery of refrigerant to the site with Contractor in charge. Store in a dry/clean environment until storage room of building is complete.

1.6 WARRANTY:

A. Warranty shall not begin until the Owner has accepted the temperature control system.

PART 2 - PRODUCTS

2.1 SUMMARY:

A. The contractor shall furnish and install centrifugal water chillers as shown and scheduled in the plans. The units shall be installed in accordance with this specification and produce the specified tonnage per the scheduled data in accordance with AHRI 550/590. The unit shall bear the AHRI certification label as applicable.

2.2 MANUFACTURERS:

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Water Cooled Chillers:
   a. Haskris

2.3 WATER COOLED CHILLERS:

A. The chiller shall be custom manufactured and customarily paired with the imaging equipment in question with all necessary accessories appurtenances and options necessary for full function of the imaging equipment in manner intended by imaging equipment manufacturer.

B. Chiller shall be a complete factory package. Unit shall be factory assembled, piped, wired, leak tested and painted with a minimum of two coats of primer paint and two coats of finish paint.

C. The following refrigerants are acceptable: R-407C

2.4 CONTROLS:

A. The chiller(s) shall be controlled by a stand-alone System. A dedicated chiller control panel is to be supplied with each chiller by the chiller manufacturer. The panel shall be microprocessor-based, with factory wired and test for all required control components for reliable equipment operation.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL:

A. Install chillers in accordance with manufacturer’s installation instructions.

B. Install chillers plumb and level, firmly anchored, and maintain manufacturer's recommended clearances for servicing and maintenance.
C. Maintain manufacturer’s recommended clearance for service and maintenance.

D. Connect piping to chiller with shutoff valves and flanges at each connection.

E. Label the amount of refrigerant in the system in pounds.

F. Provide flanges at each condenser and chilled water connection to chiller. Provide removable sections to permit removal for access to tube bundles for cleaning. Pipe sections shall be no longer than 2 feet or shall consist of a removable elbow in order to be removable without heavy equipment.

G. Place isolation valves on piping to permit removal of sections described above without draining of chilled or condenser water.

H. Controls:
   1. Wire chiller so it cannot start unless chilled water and condenser water circulating pumps are running.
   2. Start and stop chillers automatically through the chiller control panel.

3.2 TESTING, CLEANING, AND CERTIFICATION

A. Test each chiller before shipment. Provide certified test report to confirm performance, include capacity test, power consumption test, and Part Load Value at ARI standard conditions.

B. Complete manufacturer’s installation and startup checklist.

C. Test and adjust controls and safeties.

D. Flush and clean chillers according to manufacturer’s instructions.

3.3 COMMISSIONING (DEMONSTRATION)

A. Provide services of a factory authorized service representative to provide startup services and to demonstrate and train the university’s representative.

B. Provide 4 hours of instruction to the university’s representative. Include operation of chillers including accessories and controls, procedures for startup and shutdown, troubleshooting, servicing, and preventive maintenance. Review data in the maintenance manuals.

END OF SECTION 23 64 16
SECTION 27 00 00 – CENTRAL HVAC EQUIPMENT

1.1 SUBMITTALS

A. Refer to division 1 of the base contract with the owner and basic mechanical requirements for administrative and procedural requirements for submittals.

B. Product data: submit industry standards and manufacturer's technical product data, installation instructions, and dimensioned drawings for each type of pipe and pipe fitting. Submit piping schedule showing pipe or tube weight, fitting type, and joint type for each piping system.

1.2 QUALITY ASSURANCE:

A. Comply with SMACNA’s “HVAC duct construction standards, second edition” and SMACNA’s “HVAC air duct leakage test manual”.

B. ASHRAE standards: comply with ASHRAE systems and equipment handbook.

C. NFPA compliance: comply with NFPA 90a “standard for the installation of air conditioning and ventilating systems” and NFPA 90b “standard for the installation of warm air heating and air conditioning systems”.

D. Filter media shall be ANSI/UL 900 listed, class 1 or class 2, as approved by local authorities.

E. Air terminals shall comply with ARI 880, “industry standard for air terminals” and shall bear the ARI certification seal.

1.3 MANUFACTURERS:

A. Acceptable manufacturers: subject to compliance with requirements, provide products by the following:

   1. Fan Coil Units:
      a. McQuay
      b. International Environmental

B. Fan Coil Units:

   1. Low pressure casings, less than 1-1/2 inch static pressure: Single wall construction, galvanized steel with 1-inch, 3/4-pound mat faced glass fiber insulation.

   2. Access Doors: Same material and finish as cabinet with hinges, latches, handles, and gaskets. Provide neoprene gaskets around full perimeter of access doors.
3. Fan Section:
   a. Fan statically and dynamically balanced for continuous operation at maximum rated fan speed and motor power.
   b. Shaft: Hot-rolled steel; turned, ground, and polished, with keyway to secure fan wheel hub. Shaft shall not pass through its first critical speed as the unit comes up to its rated rpm.
   c. Shaft Bearings: Greasable, self-aligning, pillow block type ball or roller bearings with L50 rated bearing life of 200,000 operating hours. Factory lubricated and equipped with grease fittings extended to the motor side of fan.

4. Coil Module
   a. Insulated, 16 gauge galvanized steel casing for heating and cooling coils. Coil headers and return bends enclosed in casing. Coils accessible for service and removable through access doors or removable panels.
   b. Water Coils: Drainable with threaded plugs. Serpentine with return bends or return headers. Coils tested to 300 psig air pressure under water. Coil circuited for counter flow of air and water.

5. Filter Module:
   a. Galvanized steel filter racks, access door, and block-offs to prevent air bypass around filters.
   b. Provide minimum 12” space between filter rack for installation of differential pressure gauge.


7. Spare Parts: Refer to Section 01 78 46 – Extra Stock Materials.

1.4 INSTALLATION, GENERAL

A. Accessories:
   1. Install access doors of sufficient size at all fire damper, filter, or coil location to provide for cleaning and inspection.
   2. Where fire dampers are installed, paint duct red at damper.
   3. Provide tight fitting access doors sealed with gaskets for inspection and replacement of fusible links. Doors shall be installed, so access is unobstructed. Where these doors occur on concealed ducts, provide access doors in walls or ceiling properly aligned to permit the servicing of the fusible links. Mark ceiling or walls according to accepted identification.

B. Ductwork:
   1. Maximum flexible ductwork length shall be 6 feet. Secure flexible ductwork to collars with metal bands. Support at least every 3 feet.
2. General: install each run with minimum number of joints. Align ductwork accurately at connections, within 1/8-inch misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with suitable ties, braces, hangers and anchors of type that will hold ducts true to shape and to prevent buckling, popping or compressing. Support vertical ducts at every floor.

3. Construct ductwork to the following pressure calculations:
   a. Lab exhaust ductwork: 2 inch wg negative static pressure.
   b. Medium pressure supply ductwork: 2 inch wg positive static pressure
   c. Low pressure supply ductwork: 1 inch wg positive pressure
   d. Supply ductwork serving biological safety cabinets (high and low pressure): 2 inch wg positive static pressure.

4. Inserts: install concrete inserts for support of ductwork in coordination with form work, as required to avoid delays in work.

5. Field fabrication: complete fabrication of work at project as necessary to match shop fabricated work and accommodate installation requirements.

6. Routing: run ductwork in shortest route that does not obstruct useable space or lock access for servicing building and its equipment. Hold ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of the building. Limit clearance to 1/2 inch where during is shown for enclosure or concealment of ducts, but allow for insulation thickness. Locate insulated ductwork for 1 inch clearance outside of insulation. In finished and occupied spaces, conceal ductwork from view, by locating in mechanical shafts, hollow wall construction or above suspended ceilings, do not encase horizontal runs in solid partitions, except as specifically shown. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.


8. Transitions: diverging transitions shall not exceed 15 degrees per side. Converging transitions shall not exceed 30 degrees per side.

9. Elbows: use radius elbows with throat radius equal to duct depth wherever possible.

10. Flexible duct fan connections: install flexible duct with at least one inch slack to insure that no vibration is transmitted from fan to ductwork.

11. Penetrations: where ducts pass through interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same gage as the duct. Overlap opening on all four sides by at least 1-1/2 inch. Fasten to duct only.
12. Coordination: coordinate duct installations with installation of accessories, dampers, coil frames, equipment controls and other associated work of ductwork system.

13. Temporary closure: at ends of ducts which are not connected to equipment or air distribution devices at the time of the 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.

C. Sealing of ducts:
   1. General:
      a. All ducts, seams, and joints (lateral and horizontal) shall be sealed with sealant.
      b. Metal surfaces to be joined shall be clean, dry, and grease free.
      c. Apply a heavy brush coat of sealant to the interior metal surface of the duct slip joint, then interlock securely the duct sections and position into place.
      d. Apply a heavy brush coat finish of sealant to the exterior metal surface duct joint or seam covering heads of lock joint screws. Ensure that all voids are completely filled to provide a continuous air pressure seal.
      e. Where ducts are subject to excessive vibration or mechanical abuse, the exterior joint finish shall consist of a heavy coat of brush applied sealant reinforced with 2-inch wide glass fabric. Press the reinforcing fabric into the wet sealant and cover with a second coat of brush applied sealant.
   2. Low pressure ducts: seal in accordance with SMACNA standards for class b seals.
   3. Medium and high pressure ducts: seal in accordance with SMACNA standards for class a seals.

D. Grilles, registers, and diffuser installation:
   1. In moist areas, install grilles, registers, and diffuser with stainless steel or aluminum fasteners.
   2. When installing grilles, registers, and diffusers in existing drop ceilings provide additional t-sections as required for a finished opening for the grille, register, or diffuser.
   3. All grilles and diffusers mounted in hard ceiling, must be set in frame and be removable to limit the use of access doors

E. Access panels:
   1. Install access panels for inspection, maintenance, and cleaning of all automatic dampers, fire and smoke dampers, duct turning vanes, before and after all coils, and at other locations where equipment will require service.
2. Access panels to fire dampers shall be labeled with letters not less than 1/2-inch in height reading "fire damper." For locations where access panels are insulated, provide identifying labels on the exterior of the insulation.

1.5 TESTING, CLEANING, AND CERTIFICATION

A. Air cleaning devices: systems shall not be operated during construction.

B. Leakage tests: conduct duct leakage test in accordance with SMACNA HVAC air duct leakage test manual. Repair leaks and repeat tests until total leakage is less than the maximum permissible leakage as specified below.

C. General:

1. Ductwork pressure tests shall be observed by architect/engineer prior to installation of insulation.

2. Ductwork systems in the three-inch w.g. pressure class and higher shall be tested in their entirety for leaks. Arbitrary sections of ductwork in the two inch w.g. and lower pressure class shall be tested as required by the engineer.

D. All tests shall be witnessed by the university’s representative and approved by architect/engineer and the university representative, coordinated through the project manager.

END OF SECTION
PART 1 - GENERAL:

1.1 RELATED DOCUMENTS:

A. All drawings associated with the entire project, including general provisions of the Contract, including The General Conditions of the Contract for Construction, General and Supplementary Conditions and Division-1 Conditions specification sections shall apply to the Division 26 specifications and drawings. The Contractor shall be responsible for reviewing and becoming familiar with the aforementioned and all other Contract Documents associated with the project.

B. Related Sections: Refer to all sections in Division 23. Refer to Division 26 and 28 specification sections and Division 26 and 28 drawings.

C. Where contradictions occur between this section and Division 1, the more stringent requirement shall apply.

D. Contractor shall be defined as any and all entities involved with the construction of the project.

E. Refer to UCD Campus Standards for more requirements.

1.2 SUMMARY:

A. This Section specifies the basic requirements for electrical installations and includes requirements common to more than one section of Division 26 and Division 28. It expands and supplements the requirements specified in sections of Division 1 through 23.

1.3 ELECTRICAL INSTALLATIONS:

A. Drawings are diagrammatic in character and do not necessarily indicate every required conduit, box, fitting, etc.

B. Drawings and specifications are complementary. Whatever is called for in either is binding as though called for in both. Report any discrepancies to the Engineer and obtain written instructions before proceeding. Where any contradictions occur between the specifications and the drawings the more stringent requirement shall apply. The contractor shall include pricing for the more stringent and expensive requirements.

C. Drawings shall not be scaled for rough-in measurements or used as shop drawings. Where drawings are required for these purposes or have to be made from field measurement, take the necessary measurements and prepare the drawings.

D. The exact location for some items in this specification may not be shown on the drawings. The location of such items may be established by the Engineer during the progress of the work.
E. The contractor shall make the installation in such a manner as to conform to the structure, avoid obstructions, preserve headroom and keep openings and passageways clear, without further instructions or costs to the Owner. All equipment shall be installed so access is maintained for serviceability.

F. Before any work is begun, determine that equipment will properly fit the space and that conduit can be run as contemplated without interferences between systems, with structural elements or with the work of other trades.

G. Verify all dimensions by field measurements.

H. Arrange for chases, slots, and openings in other building components to accommodate electrical installations.

I. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring an access path for positioning prior to closing-in the building or space.

J. Where mounting heights are not detailed or dimensioned, install electrical conduits, boxes, and overhead equipment to provide the maximum headroom possible. In general, keep installations tight to structure.

K. Install electrical equipment to facilitate maintenance and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting and removal with minimum of interference with other installations.

L. Make allowance for expansion and contraction for all building electrical components and conduit systems that are subject to such.

M. The ceiling space shall not be “layered”. It is the contractor’s responsibility to offset and coordinate any systems as required to allow installation within the identified ceiling cavity. The contractor shall include labor and material in the base bid to accommodate such offsets.

N. In general, all conduit systems shall be routed as high as possible. Keep all equipment in accessible areas such as corridors and coordinate with systems and equipment from other sections.

O. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.

P. Coordinate the installation of electrical materials and equipment above and below ceilings with suspension system, luminaires and other building components. Ductwork and piping shall not be installed above electrical panelboards, switchboards, motor control centers, and transformers.

1.4 COORDINATION:

A. Work out all installation conditions in advance of installation. The Contractor shall be responsible for preparing coordination drawings, showing all work, in all areas. The
Contractor shall be responsible for providing all labor and material, including but not limited to all fittings, hangers, control devices, lighting, low voltage equipment, cable tray, conduit, transformers, disconnects, etc., necessary to overcome congested conditions at no increase in contact sum. The Contractors base bid shall include any and all time and manpower necessary to develop such coordination efforts and drawings. Increases to contract sum or schedule shall not be considered for such effort.

B. Provide proper documentation of equipment, product data and shop drawings to all entities involved in the project. Coordination shall include, but not be limited to the following:

1. Fire Alarm Contractor shall provide shop drawings to other Contractors as required.
2. Automatic Temperature Controls, Building Management and Testing, Adjusting and Balancing Contractors shall be provided with equipment product data and shop drawings from other Division 23 and Division 26 Contractors and shall furnish the same information involving control devices to the appropriate Contractor.
3. Automatic Doors and controls, Elevators and other building access equipment shall have cut sheets reviewed and shall furnish the same information to the appropriate Contractor.

C. Coordination Drawings:

1. Coordination drawings shall be prepared by the Contractor for his utilization and are his responsibility to assure systems will be installed in a manner to allow all systems to function properly.

D. Existing Conditions:

1. Contractor shall carefully survey existing conditions prior to bidding work. In addition, Contractor shall complete a thorough ceiling cavity survey.
2. Provide proper coordination of electrical work with existing conditions.
3. Contractor shall report any issues or conflicts immediately to Engineer before commencing with work and prior to purchasing equipment and materials.

1.5 COORDINATION WITH OTHER DIVISIONS:

A. General:

1. Coordinate all work to conform to the progress of the work of other trades.
2. Complete the entire installation as soon as the condition of the building will permit. No extras will be allowed for corrections of ill-timed work, when such corrections are required for proper installation of other work.

B. Coordinate ceiling cavity space carefully with all trades. In the event of conflict, install mechanical and electrical systems within the cavity space allocation in the following order of priority:

1. Equipment and required clearances
2. Plumbing waste, cooling coil drain piping and roof drain mains and leaders.
3. Ductwork mains.
4. Plumbing vent piping.
5. Medical gas/lab gas systems.
6. Low pressure ductwork and air devices.
7. Electrical and communication conduits, raceways and cable tray.
8. Domestic hot and cold water.
9. Hydronic piping.
10. Fire sprinkler mains, branch piping and drops (locate as tight to structure as possible).
11. DDC control wiring and other low voltage systems.
12. Fire alarm systems.

C. Chases, Inserts and Openings:
   1. Provide measurements, drawings and layouts so that openings, inserts and chases in new
      construction can be built in as construction progresses.
   2. Check sizes and locations of openings provided, including the access panels for
      equipment in hard lid ceilings and wall cavities.
   3. Any cutting and patching made necessary by failure to provide measurements, drawings
      and layouts at the proper time shall be done at no additional cost in contract sum.

D. Support Dimensions: Provide dimensions and drawings so that concrete bases and other
   equipment supports to be provided under other sections of the specifications can be built
   at the proper time.

E. Coordinate the installation of required supporting devices and sleeves to be set in poured
   in place concrete and other structural components, as they are constructed.

F. Coordinate the cutting and patching of building components to accommodate the
   installation of electrical equipment and materials.

G. Modifications required as result of failure to resolve interferences, provide correct
   coordination drawings or call attentions to changes required in other work as result of
   modifications shall be paid for by responsible Contractor/Subcontractor.

1.6 DESIGN WORK REQUIRED BY CONTRACTOR:

A. The construction of this project requires the Contractor to include the detailing and
   design of several systems and/or subsystems. All such design work associated with the
   development of the coordination drawings shall be the complete responsibility of the
   Contractor.

B. The Contractor shall take the full responsibility to develop and complete routing
   strategies which will allow fully coordinated system to be installed in a fully functional
   manner. The Engineers contract drawings shall be for system design intent and general
   configurations.

C. Systems or subsystems which require design responsibility by the contractor include but
   are not limited to:
   1. Temporary Facilities.
   2. Any system not fully detailed.
3. Equipment supports, hangers, anchors and seismic systems not fully detailed nor specified in these documents, or catalogued by the manufacturer.
4. Seismic restraint systems.

1.7 PROJECT CONDITIONS:

A. The contractor shall be required to attend a pre-bid walk-thru if required and shall make themselves familiar with the existing conditions. No additional costs to the Owner shall be accepted for additional work for existing conditions.

B. Field verify all conditions prior to submitting bids.

C. Report any damaged equipment or systems to the Owner prior to any work.

D. Protect all work against theft, injury or damage from all causes until it has been tested and accepted.

E. Be responsible for all damage to the property of the Owner or to the work of other contractors during the construction and guarantee period. Repair or replace any part of the work which may show defect during one year from the final acceptance of all work, provided such defect is, in the opinion of the Architect, due to imperfect material or workmanship and not due to the Owner's carelessness or improper use.

F. The Contractor shall coordinate and co-operate with Owner at all times for all new to existing connections.

G. Provide temporary electrical connections where required to maintain existing areas operable.

H. Coordinate all services shut-down with the Owner; provide temporary services. Coordinate any required disruptions with Owner, at a minimum one week in advance.

I. Minimize disruptions to operation of electrical systems in occupied areas.

1.8 SAFETY:

A. Refer to Division 1.

1.9 EQUAL EMPLOYMENT OPPORTUNITY REQUIREMENTS:

A. Refer to Division 1 and conform with the Owners requirements.

1.10 REQUIREMENTS OF REGULATORY AGENCIES:

A. Refer to Division 1.

B. Execute and inspect all work in accordance with Underwriters Laboratories (UL), and all local and state codes, rules and regulations applicable to the trade affected as a minimum, but if the plans and/or specifications call for requirements that exceed these rules and regulations, the more stringent requirement shall be followed. Follow application
sections and requirements and testing procedures of NFPA, IEEE, NEMA, CBM, ANSI, NECA, ICEA and IETA.

C. Comply with standards in effect at the date of these Contract Documents, except where a standard or specific date or edition is indicated.

D. Energy Codes: All equipment and installations shall conform to Federal, State, and local Energy Conservation Standards.

E. The handling, removal and disposal of regulated liquids or other materials shall be in accordance with U.S. EPA, state and local regulations.

F. The handling, removal and disposal of lead based paint and other lead containing materials shall comply with EPA, OSHA, and any other Federal, State, or local regulations.

G. After entering into contract, Contractor will be held to complete all work necessary to meet these requirements without additional expense to the Owner.

H. All material used on this project shall be UL listed and labeled and be acceptable to the authority having jurisdiction as suitable for the use intended.

1.11 PERMITS AND FEES:

A. Refer to Division 1.

B. Contractor shall pay all fees required for connection to municipal and public utility facilities.

C. Contractor shall arrange for and pay for all inspections, licenses and certificates required in connection with the work.

1.12 PROJECT SEISMIC REQUIREMENTS:

A. Installation shall comply with the local seismic requirements for the area of installation. Provide restraints, bracing, anchors, vibration isolation, seismic snubbers, and all other components required for the installation.

B. All electrical and fire alarm systems shall be installed to meet NFPA and IBC Seismic requirements.

1. Where any conflicts arise the more stringent requirements shall be applicable.
2. The design of the seismic requirements shall be the responsibility of the contractor.

1.13 TEMPORARY FACILITIES:

A. Light, Heat, Power, Etc. Responsibility for providing temporary electricity, heat and other facilities shall be as identified in these specifications, as shown on the drawings and as specified in Division 1.
B. Building distribution equipment and devices (existing or new) shall not be used without written permission of the Owner. If used for temporary power, the equipment shall be properly maintained and any damage resulting from use shall be repaired by the Contractor. The guarantee period for new equipment shall not begin until the equipment is turned over to the Owner.

C. If AC power systems or their backup systems serving telecommunications, computer equipment, or their associated HVAC equipment and controls are taken out of service, for any reason, the Contractor shall be responsible for providing temporary systems during the period when the AC power systems or their backup systems are out of service. The Contractor shall be responsible for providing temporary power to all loads being interrupted.

1.14 PRODUCT OPTIONS AND SUBSTITUTIONS:

A. Refer to the Instructions to Bidders and Division 1.

B. The burden of proof that proposed equipment is equal in size, capacity, performance, and other pertinent criteria for this specific installation, or superior to that specified is up to the Contractor. Substituted equipment will only be allowed where specifically listed in a written addendum. If substitutions are not granted, the specified materials and equipment must be installed. Where substituted equipment is allowed, it shall be the Contractor's responsibility to notify all related trades of the accepted substitution and to assume full responsibility for all costs caused as a result of the substitution.

C. Materials and equipment of equivalent quality may be submitted for substituted prior to bidding. This may be done by submitting to the Architect/Engineer at least ten (10) working days prior to the bid date requesting prior review. This submittal shall include all data necessary for complete evaluation of the product.

1. Substitutions shall be allowed only upon the written approval of the Architect/Engineer NO EXCEPTIONS.
2. The Contractor shall be responsible for removal, replacement and remedy of any system or equipment which has been installed which does not meet the specifications or which does not have prior approval.

1.15 SUBMITTALS:

A. General

1. Refer to the Conditions of the Contract (General and Supplementary), Division 1.
2. The submittals shall be submitted as a fully complete package identified by the specification section. Submittals that are not complete with the required information will be sent back to be corrected.
3. The Contractor shall identify any "long lead time" items which may impact the overall project schedule. If these submittal requirements affect the schedule, the Contractor shall identify the impacts and confer with the Engineer within two weeks of entering into the contract.
4. The front of each submittal package shall be identified with the specification section number, job name, Owner's project number, date, Prime Contractor and Subcontractor's
names, addresses, and contact information, etc. Each Specification Section shall be submitted individually and submittal shall be tabbed for the equipment/materials/etc. within the section.

5. Submittals shall be provided electronically. Submittals will be reviewed, marked appropriately and returned by the same means received.

6. An index shall be provided which includes:
   a. Product
   b. Plan Code (if applicable)
   c. Specification Section
   d. Manufacturer and Model Number

7. Submittals shall be provided for review within four (4) working weeks from award of contract to successful bidder.

B. Basis of Design: The manufacturer's material or equipment listed first in the specifications or on the drawings are the types to be provided for the establishment of size, capacity, grade and quality. If alternates are used in lieu of the first names, the cost of any changes in construction required by their use shall be borne by this Contractor.

C. Contractor Review: Submittal of shop drawings, product data, and samples will be accepted only when submitted by the Contractor. Each submittal shall be reviewed by the contractor for general conformance with contract requirements and stamped by the respective contractor prior to submittal to the Architect/Engineer. All submittals need to be complete. Any submittal not stamped or complete will be sent back. Data submitted from subcontractors and material suppliers directly to the Architect/Engineer will not be processed unless written prior approval is obtained by the Contractor.

D. Submittal Review Process: Before starting work, prepare and submit to the Architect/Engineer shop drawings and descriptive product data. Continue to submit in the stated format after each Architect/Engineer's action until a "No Exception Taken" or "Make Correction Noted" action is received. When a "Make Corrections Noted" is received, make the required corrections for inclusion in the operation and maintenance manual. Submittals marked "Make Corrections Noted" shall not be resubmitted during the submittal process. Unless each item is identified with specification section and sufficient data to identify its compliance with the specifications and drawings, the item will be returned "Revise and Resubmit". Where an entire submittal package is returned for action by the Contractor, the Engineer will summarize comments in letter format and return the entire set. Submittals shall be prepared per the ELECTRICAL SUBMITTAL CHECKLIST, paragraph 1.35 of this section; supplemental requirements are listed in each Division 26 Section.

E. The Design Professional’s review and appropriate action on all submittals and shop drawings is only for the limited purpose of checking for conformance with the design concept and the information expressed in the contract documents. This review shall not include:
   1. Accuracy or completeness of details, such as quantities, dimensions, weights or gauges, fabrication processes
   2. Construction means or methods
3. Coordination of the work with other trades
4. Construction safety precautions

F. The Design Professional’s review shall be conducted with reasonable promptness while allowing sufficient time in the Design Professional’s judgment to permit adequate review. Review of a specific item shall not indicate that the Design Professional has reviewed the entire assembly of which the item is a component.

G. The Design Professional shall not be responsible for any deviations from the contract documents not brought specifically to the attention of the Design Professional in writing by the Contractor. This shall clearly identify the design and the specific element which vary from the Design. The Contractor shall be responsible for all remedy for lack of strict conformance associated with this criteria.

H. If more than two submittals (either for product data, shop drawings, record drawings, test reports, or O&M’s) are made by the Contractor, the Owner reserves the right to charge the Contractor for subsequent reviews by their consultants. Such extra fees shall be deducted from payments by the Owner to the Contractor.

I. The contractor shall cloud all changes made on submittals that are marked “Revise and Resubmit.”

J. Submit proposed changes to electrical room or other equipment room layouts when revised from contract documents prior to installation.

K. Mark submittals with designations as shown on the drawings and identify as required by Specification Sections. Identification shall contain the information as required in details and each label shall be submitted in list form with disconnects, MCC's, panelboards, switchboards, overcurrent protection devices and utilization equipment.

L. The Design Professional shall not be required to review partial submissions or those for which submissions of correlated items have not been received.

1.16 SPECIFIC CATEGORY SUBMITTAL REQUIREMENTS:

A. Product Listing:
   1. Prepare listing of major electrical equipment and materials for the project, within (2) two weeks of signing the Contract Documents and transmit to the Architect
      a. Provide all information requested.
      b. Submit this listing as a part of the submittal requirement; see Paragraph 1.15 "PRODUCT OPTIONS AND SUBSTITUTIONS."
   2. Unless otherwise specified, all materials and equipment shall be of domestic (USA) manufacture and shall be of the best quality used for the purpose in commercial practice.
   3. When two or more items of same material or equipment are required (wiring devices, protective devices, etc.) they shall be of the same manufacturer. Product manufacturer uniformity does not apply to raw materials, bulk materials steel bar stock, welding rods, solder, fasteners, except as otherwise indicated.
a. Provide products which are compatible within systems and other connected items.

4. For conduit, wire and fittings, the Contractor shall select a prime and alternate manufacturer from the list of acceptable manufacturers provided in the appropriate sections of this Division. The prime and alternate manufacturers shall be identified in the product listing. The contractor shall make every effort to use the prime manufacturer for the entire project. If products from this manufacturer are unavailable, the Contractor shall use the listed alternate with the following provisions.

   a. Wire: All wire placed in a single conduit or installed in multiple conduits making up parallel feeders shall be of the same manufacturer.
   b. Conduit and Fittings: All conduits and fittings installed exposed within the same room or immediate area shall be of the same manufacturer.

B. Schedule of Values

1. Provide Preliminary Schedule of Values to Engineer with product data submittal within four (4) weeks from award of contract to successful bidder. Provide according to the following descriptions:
   a. General Construction (total)
   b. Demolition
   c. Basic Materials/Devices/Equipment Connections (Mechanical)

2. Provide a final Schedule of Values at close-out of project including updated values based on actual installation.

C. Product Data:

1. Where pre-printed data covers more than one distinct product, size, type, material, trim, accessory group or other variation, mark submitted copy with black pen to indicate which of the variations is to be provided.
2. Delete or mark-out portions of pre-printed data which are not applicable.
3. Where operating ranges are shown, mark data to show portion of range required for project application.
4. For each product, include the following:
   a. Sizes.
   b. Weights.
   c. Speeds.
   d. Capacities.
   e. Conduit and electrical connection sizes and locations.
   f. Statements of compliance with the required standards and regulations.
   g. Performance data.
   h. Manufacturer's specifications.

5. Checklist: Where identified in ELECTRICAL SUBMITTAL CHECKLIST or within individual Division 26 Sections or necessary for confirmation of products, submit a detailed checklist which acknowledges compliance or a reason for non-compliance to each of the specification requirements. Arrange the checklist according to the headings
of each item identified in each specification (i.e. Shop Drawings, Wiring Diagrams, Product requirements, individual line items, etc.) Mark items as "N/A" where the item is not applicable.

D. Shop Drawings:

1. Shop Drawings are defined as electrical system layout drawings prepared specifically for this project, or fabrication and assembly type drawings of system components to show more detail than typical pre-printed materials.
2. Prepare Electrical Shop Drawings, except diagrams, to accurate scale, min 1/8"-1'-0", unless otherwise noted.
3. Shop drawings shall include:
   a. Proposed equipment installations.
   b. Electrical characteristics and connection requirements.
   c. Clearance dimensions at critical locations.
   d. Dimensions of spaces required for operation and maintenance.
   e. Interfaces with other work, including structural support.
   f. Elevations when necessary in areas with multiple pieces of equipment on common walls or to clarify incoming/exiting methods/clearances, etc.
   g. Wall and floor penetrations.
   h. Wiring diagrams shall showing all components, internal connecting wiring, and contractor connection requirements including terminal blocks/lugs, wire sizes, etc.

E. Test Reports:

1. Submit test reports which have been signed and dated by the accredited firm or testing agency performing the test.
2. Prepare test reports in the manner specified in the standard or regulation governing the test procedure (if any) as indicated.
3. Submit test reports as required for O & M manuals.

F. Operation and Maintenance Data: See section 1.30 of this specification section.

G. Equipment Settings Report: Where identified in the ELECTRICAL SUBMITTAL CHECKLIST or within individual Division 26 Sections or necessary for confirmation of products, submit Equipment Settings Report for each device indicating final configurations and settings. Report shall be submitted and received by the Engineer at least fifteen calendar days prior to the contractor's request for final observation (include circuit breaker, relay, transformer tap, lighting control settings, and other equipment settings). Include in the O & M Manual after review with "No Exceptions Taken" has been accomplished.

H. Record Drawings: See section 1.29 of this specification section.

1.17 DELIVERY, STORAGE AND HANDLING:

A. Refer to the Division 1, Sections on Transportation and Handling and Storage and Protection.
B. Deliver products to project properly identified with names, model numbers, types, grades, compliance labels, and similar information needed for distinct identifications; adequately packaged and protected to prevent damage during shipment, storage, and handling.

C. Check delivered equipment against contract documents and submittals.

D. Store equipment and materials at the site, unless off-site storage is authorized in writing. Protect stored equipment and materials from damage and weather.

E. Coordinate deliveries of electrical materials and equipment to minimize construction site congestion. Limit each shipment of materials and equipment to the items and quantities needed for the smooth and efficient flow of installations.

1.18 DEMOLITION/REMODEL WORK:

A. Refer to Division 1 Section on Summary of work for requirements on working in Owner-occupied areas of the existing building and Division 2 section on selective demolition. The following are additions and modifications.

B. During the demolition phase of this contract it is the responsibility of this Contractor to carefully remove existing equipment, conduits, boxes, and related items either as shown on the demolition drawings as being removed, or as required for the work. These items shall be tagged, protected from damage and stored as directed by the Owner. A list of all items stored shall be turned over to the Architect/Engineer. At the completion of the remodeling work or when directed by the Architect, all stored items not reused or wanted by the Owner shall be removed from the premises.

C. The project involves renovation and remodel of the existing building. On the drawings, work may be denoted by showing items as bold or light line weight and certain renovation symbols are used. These indications and symbols are amplified as follows:

1. Bold Print (when used): Work included in this contract is denoted in bold print or darker line weight.
2. Light Print (when used): Work shown lightly indicates existing conditions to remain.

D. Existing equipment that is removed and not scheduled to be reused shall remain the property of the Owner and be delivered for disposition unless specifically indicated otherwise and shall be stored in a location designated by the Owner. Items which are removed and not wanted by the Owner shall become the property of the Contractor and shall be removed from the site.

E. Existing equipment that is removed and is to be reused shall be cleaned, serviced and operable before being reinstalled.

F. Revise panelboard schedules to reflect removal or relocation of equipment. Circuit integrity of equipment in adjacent areas shall be left intact.

G. Where remodeling interferes with existing circuits and equipment which are not to be removed, such circuits and equipment shall be reworked and relocated as required to complete the project.
H. The Contractor shall remove all distribution equipment, conductors, etc., which are indicated to be removed or which must be removed to accommodate demolition. Equipment to be removed may require reworking conduit and wiring in order to maintain service to other equipment.

I. Where remodeling interferes with circuits serving areas outside of the project or phase limits or which are remodeled in later phases of the project, circuits shall be reworked or temporary circuits provided as required.

J. Existing equipment and circuiting shown are based on field surveys and/or Owner furnished drawings. The Contractor shall verify conditions as they exist with necessary adjustments being made to the drawing information.

K. Coordinate the routing of all conduits with the existing mechanical and plumbing systems in order to avoid conflicts with ducts, pipes, etc. Where existing electrical boxes, conduit, or equipment interfere with installation of new ducts, plumbing, walls, soffits, luminaires, outlets, etc., the Contractor shall resolve the conflict with the appropriate trade.

L. Reuse of existing luminaires, devices, conduits, boxes, or equipment will be permitted only where specifically indicated on the drawings or allowed under the appropriate section of the specifications.

M. Electrical Outages: Electrical outages must be held to a minimum. The Contractor shall submit a Method of Procedure (MOP) for each outage to the Owner, detailing the reasons for the outage, areas affected, sequence of procedures to accomplish work, estimated maximum length of time along with the date and time of day outage will occur. The Contractor shall meet with the Owner to set a schedule and date for the outage based on the MOP. Due to the critical implications of power outages, the Owner may direct the Contractor as to the time of day or night and date an outage may take place.

1. The Contractor will be responsible for providing temporary power required for the duration of the outages. The required outages to connect and disconnect the temporary power will require a MOP as described above.

N. PCB Ballasts: PCB type ballasts may be present in existing luminaires. If PCB ballasts are discovered by the Contractor, report such occurrence to the Owner immediately. The Contractor shall remove and dispose of PCB type ballasts at an E.P.A. (Environmental Protection Agency) approved site in the prescribed manner acceptable to the EPA. The Contractor shall pay all fees associated with this work.

O. Hazardous Material: If suspected hazardous material, in any form, is discovered by this Contractor in the process of his work, he shall report such occurrence to the Owner immediately. The Owner will determine the action to be taken. Hazardous material removed is not a part of the work to be done under this Division.

P. Lamp Disposal: Contractor is responsible for sending removed lamps to be recycled. The Contractor should ensure the recycling agency meets RCRA and CERCLA regulations. Provide certificate of compliance in O&M Manuals.
Q. On Site Metering: When called for in the specifications or on the drawings, the Contractor shall meter the points indicated for a period of 30 days prior to start of construction to verify existing load. Meter shall record voltage; amperage; KVA; and Power Factor for each phase and sum of the phases. The meter shall continually average the power demand over maximum 15 minute intervals as required by NEC 220.87. Compile a metering summary report and deliver results to engineer after 7 days and after 30 days. Verify existing loads at and downstream of the metering location and provide list to engineer of what loads are not on during the 30 day metering and the reason why. Organize list by equipment name. If any loads have been removed or permanently abandoned, Turn circuit breaker off and relabel as SPARE.

1.19 CUTTING AND PATCHING:

A. This Article specifies the cutting and patching of electrical equipment, components, and materials to include removal and legal disposal of selected materials, components, and equipment. Coordinate the cutting and patching of building components to accommodate the installation of electrical equipment and materials.

B. Refer to the Division 1 Section covering cutting and patching for general requirements.

C. Do not endanger or damage installed Work through procedures and processes of cutting and patching.

D. Arrange for repairs required to restore other work, because of damage caused as a result of electrical installations.

E. No additional compensation will be authorized for cutting and patching Work that is necessitated by ill-timed, defective, or non-conforming installations.

F. Perform cutting, fitting, and patching of electrical equipment and materials required to:

1. Uncover Work to provide for installation of ill-timed Work;
2. Remove and replace defective Work;
3. Remove and replace Work not conforming to requirements of the Contract Documents;
4. Remove samples of installed Work as specified for testing;
5. Install equipment and materials in existing structures;
6. Upon written instructions from the Architect/Engineer, uncover and restore Work to provide for Architect/Engineer observation of concealed Work.

G. Cut, remove and legally dispose of selected electrical equipment, components, and materials as indicated, including, but not limited to removal of conductors, conduit, luminaires, boxes, devices and other electrical items made obsolete by the new Work.

H. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

I. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.
J. Locate, identify, and protect electrical services passing through remodel or demolition area and serving other areas required to be maintained operational.

1.20 ROUGH-IN:

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

B. Refer to equipment shop drawings and manufacturer's requirements for actual provided equipment for rough in requirements.

C. Work through all coordination before rough-in begins.

1.21 ACCESSIBILITY:

A. Install equipment and materials to provide required code clearances and access for servicing and maintenance. Coordinate the final location with piping, ducts, and equipment of other trades to insure proper access for all trades. Coordinate locations of concealed equipment, disconnects, and boxes with access panels and doors. Allow ample space for removal of parts, fuses, lamps, etc. that require replacement or servicing.

B. Extend all conduits so that junction and pull boxes are in accessible locations.

C. Provide access panel or doors where equipment or boxes are concealed behind finished surfaces.

D. Furnish hinged steel access doors with concealed latch, whether shown on drawings or not, in all walls and ceilings for access to all concealed valves, shock absorbers, air vents, motors, fans, balancing cocks, and other operating devices requiring adjustment or servicing. Refer to Division 1 for access door specification and requirements.

E. The minimum size of any access door shall not be less than the size of the equipment to be removed or 12 inches x 12 inches if used for service only.

F. Furnish doors to trades performing work in which they are to be built, in ample time for building in as the work progresses. Whenever possible, group valves, cocks, etc., to permit use of minimum number of access doors within a given room or space.

G. Factory manufactured doors shall be of a type compatible with the finish in which they are to be installed. In lieu of these doors, approved shop fabricated access doors with DuroDyne hinges may be used.

H. Access doors in fire rated walls and ceilings shall have equivalent U.L. label and fire rating.

1.22 TESTING:

A. Submit test reports as outlined in Division 1 Sections on Quality Control Services and each Division 26 Section.
B. Testing as required by these specifications shall pertain to all equipment, wiring, devices, etc. installed under this contract and being reused.

C. General Scope:
   1. Perform all tests and operational checks to assure that all electrical equipment, both Contractor and Owner-supplied, is operational within industry and manufacturer's tolerances and is installed in accordance with design specifications.
   2. The tests and operational checks shall determine the suitability for energization.
   3. Schedule tests and give a minimum of two weeks advance notice to the Architect. Reschedule testing for Owner convenience if required.

D. Test Report: Submit three copies of the completed report to the Architect no later than fifteen (15) days after completion of test unless directed otherwise. The test report shall be bound and its contents certified. A final compilation of all Test Reports shall be submitted with the Testing and Equipment Settings Report (Refer to Operation and Maintenance Data paragraphs).

E. Each test report shall include the following:
   1. Project information including: Building, name, address, date, and other pertinent information.
   2. List of equipment tested.
   3. Description of test.
   4. List of test equipment used and calibration date.
   5. Baseline, acceptable, or published target value for test with code or standard reference indicating where value was derived.
   6. Test results that summarize all measured values with baseline values.
   7. Conclusions and recommendations.
   8. Appendix, including appropriate test forms that show all measured values.

F. Failure to Meet Test:
   1. Any system material or workmanship which is found defective on the basis of performance tests shall be reported directly to the Architect.
   2. All failed tests shall be sent immediately by email to Engineer with proposed corrective action and proposed re-test date and time.
   3. Contractor shall replace the defective material or equipment as necessary, and have test repeated until test proves satisfactory without additional cost to the Owner.

G. The Contractor or testing agency shall have a calibration program which maintains all applicable test instrumentation within rated accuracy. The accuracy shall be traceable to the National Institute of Standards and Technology (NIST) in an unbroken chain. Instruments shall be calibrated in accordance with the following frequency schedule:
   1. Field Instruments: 6 months
   2. Laboratory Instruments: 12 months
   3. Leased specialty equipment: 12 months. (Where accuracy is guaranteed by lessor
   4. Dated calibration labels shall be visible on all test equipment.
1.23 NAMEPLATE DATA:

A. Provide equipment with permanent operational data nameplate on each item of power operated equipment, indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data. Install equipment so that nameplate is readily visible.

B. Phase Rotation

   1. Existing Building: Match existing phase rotation.

1.24 METHODS OF PROCEDURE (MOP):

A. Definition: Method of Procedure (MOP) is a written plan which describes the activities and procedures to safeguard the building's occupants and contents and to interface with the building's management, operations and security. Building occupants shall be defined as employees, patients, and visitors.

B. Requirements:

   1. An MOP is required when a construction activity affects the safety of the occupants, equipment or valuable contents, or any supporting system; or essentially affects the building's management, operations or security.
   2. An MOP is required for any shutdown or interruption of any system which affects the building occupants, including, but not limited to, infrastructure, life safety, electrical, and building management systems.
   3. An MOP is required when requested or deemed necessary by the Owner or Engineer.

C. Development:

   1. The Prime Contractor shall develop, submit, track and process the MOP. Any assistance required by the Subcontractors shall be provided. All MOPs shall be reviewed by the Prime Contractor prior to submitting the MOP to the Engineer.
   2. All MOPs Shall Be Typed.
   3. Contractor shall develop the MOP in a timely fashion prior to review and approval by all required parties.
   4. Contractor shall develop the MOP with input from the subcontractor, where necessary.

D. Form: Each MOP shall be a written document in narrative, descriptive or outline form supplemented with drawings, diagrams and schedules as necessary.

E. Review and Approval: Contractor shall submit each MOP to the Engineer for review and approval. All MOPs require Owner's approval.

F. Implementation: Contractor shall implement the MOP when approved by the Engineer and Owner in writing. No construction activity which requires a MOP shall proceed until the MOP is approved.
G. Compliance: Contractor shall comply with the approved MOP. The Owner and Engineer reserve the right to stop the work for non-compliance with the MOP. Any cost or time delay resulting from the work stoppage shall be borne by the Contractor.

H. Posting: Work shall not proceed on any facet of the work involving any MOP if an approved and signed MOP is not posted in the work area.

1.25 CLEANING:

A. Refer to the Division 1 Section on project closeout or final cleaning for general requirements for final cleaning.

B. Clean all luminaires, lamps and lenses per manufacturer’s recommendations prior to final acceptance. Replace all inoperative lamps.

1.26 RECORD DOCUMENTS:

A. Refer to the Division 1 Section on Project Closeout or Project Record Documents for requirements. The following paragraphs supplement the requirements of Division 1.

B. Keep a complete set of record document prints in custody during entire period of construction at the construction site. Documents shall be updated on a weekly basis.

C. Mark Drawings to indicate revisions to conduit size and location both exterior and interior; actual equipment locations, dimensioned from column lines; concealed equipment, dimensioned to column lines; distribution and branch electrical circuitry; fuse and circuit breaker size and arrangements; support and hanger details; Change Orders; concealed control system devices, and any other relevant deviations from the Contract Documents.

D. Mark shop drawings to indicate approved substitutions; Change Orders; actual equipment and materials used.

E. Schedules:
   1. Mark luminaire schedule on drawings to indicate manufacturer and complete catalog numbers of installed equipment.
   2. Mark schedules including panelboard, switchboard, motor control center, mechanical, kitchen and similar equipment schedules on drawings to indicate installed equipment and materials used, and any deviations or revisions to electrical load data and calculations.

F. Revisions to the Contract Documents shall be legible and shall be prepared using the following color scheme.
   1. Red shall indicate new items, deviations and routing.
   2. Green shall indicate items removed or deleted.
   3. Blue shall be used for relevant notes and descriptions.

G. At the completion of the project, obtain from the Architect a complete set of the Contract Documents in a read-only electronic format (.pdf unless otherwise noted). This set will
include all revisions officially documented through the Architect/Engineer. Using the
above color scheme, transfer any undocumented revisions from the construction site
record drawings to this complete set. Submit completed documents to the
Architect/Engineer. This contract will not be considered completed until these record
documents have been received and reviewed by the Architect/Engineer.

H. Contractor may propose methods of maintaining record documents on electronic media.
Obtain approval of Engineer and Owner prior to proceeding. Marked-up .pdf format
readable by Bluebeam is preferred.

1.27 OPERATION AND MAINTENANCE DATA:
A. Refer to the Division 1 Section on project closeout or operation and maintenance data for
procedures and requirements for preparation and submittal of maintenance manuals.

B. No later than four (4) weeks prior to the completion of the project provide complete set of
operating and maintenance manuals, or as specified in Sections of Division 1 (whichever
is more stringent). Operation and Maintenance Data shall be submitted in electronic
format.

C. Operation and Maintenance Data: Submit operation and maintenance data in maintenance
manual in accordance with requirements of applicable Division 26 Sections and Division
1. Provide Operating and Maintenance Instructions in electronic format covering all
equipment furnished. Manuals shall include all information required below, as indicated
in each Division 26 Section, and the following for each piece of equipment:

1. The job name and address, contractor’s name, address, and phone number, and each
subcontractor's name, address, and phone number shall be identified at the front of the
electronic submittal.

2. Name, address and telephone number to be contacted of the local authorized service
organization/company and individual to be contacted for service and maintenance for
each item of equipment.

3. Submit operation and maintenance data, schedule of recommended service and parts lists
for all materials and products specified and intended for installation. Include description
of function, normal operating characteristics and limitations, fuse curves, engineering
data and tests, and complete nomenclature and commercial numbers of all replaceable
parts.

4. Manufacturer's printed operating procedures to include start-up, break-in, routine and
normal operating instructions; regulation, control, stopping, shut-down, and emergency
instructions; and summer and winter operating instructions.

5. Maintenance procedures for routine preventative maintenance and troubleshooting;
disassembly, repair, and reassembly; aligning and adjusting instructions.

6. Servicing instructions and lubrication charts and schedules.

7. Manufacturer's service manuals for all electrical equipment provided under this contract.

8. Complete equipment and protection wiring diagrams. All wiring diagrams shall show
color coding of all connections and mounting dimensions of equipment.

9. Equipment identification numbers and adjustment clearly indicated for each piece of
equipment.

11. Provide manuals tabbed and divided into major sections and special equipment. Mark the individual equipment when more than one model or make is listed on a page. Provide detailed table of contents.

12. Record Set of Shop Drawings: Shop drawings corrected to show as-built conditions. Transfer modifications from field set.


D. This contract will not be considered completed nor will final payment be made until all specified material, including test reports, settings reports, and final Schedule of Values with all Electrical and Information Technology change order costs included and identified is provided and the manual is reviewed by the Architect/Engineer.

1.28 PROJECT CLOSEOUT LIST:

A. In addition to the requirements specified in Division 1, complete the requirements listed below.

1. The contractor shall be responsible for providing the items listed on the Electrical Submittal Checklist prior to applying for certification of substantial completion. Refer to individual specification sections for additional requirements (Checklist is located at the end of this section.)

1.29 WARRANTIES:

A. Refer to the Division 1 Section on Warranties and Bonds for procedures and submittal requirements for warranties. Refer to individual equipment specifications for warranty requirements. In no case shall the warranty for the total electrical system be less than one year from date of acceptance by the Owner.

B. Compile and assemble the warranties specified in Division 26, into a separated set of vinyl covered, three ring binders, tabulated and indexed for easy reference.

C. Provide complete warranty information for each item. Information to include product or equipment description, date of beginning of warranty or bond; duration of warranty or bond; and names, addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services.

1.30 CONSTRUCTION REQUIREMENTS:

A. The contractor shall maintain and have available at the jobsite current information on the following at all times:

1. Up to date record drawings.
2. Submittals
3. Site observation reports with current status of all action items.
4. Test results; including recorded values, procedures, and other findings.
5. Outage information.
1.31 EQUIPMENT HOUSEKEEPING PADS:

A. Provide 4" concrete housekeeping pad for all floor mounted equipment including, but not limited to: switchgear, switchboards, motor control centers, floor mounted distribution panelboards, floor mounted branch panelboards, and floor mounted dry type transformers. Fabricate pads as follows:

1. Coordinate size of equipment bases with actual unit sizes provided. Fabricate base 4" larger in both directions than the overall dimensions of the supported unit.
2. Form concrete pads with framing lumber with form release compounds. Chamfer top edge and corners of pad.
3. Place concrete and allow curing before installation of units. Use Portland cement that conforms to ASTM C 150, 54000-psi compressive strength, and normal weight aggregate.
4. Anchor housekeeping pads to slab using #3 rebar bent in “L” or “Z” shape 12 inch on center on each side of slab.

1.32 ELECTRICAL SUBMITTAL CHECKLIST:

A. Provide submittals including product data, shop drawings, tests and reports, training, extra material, O&M manuals, product checklists, device setting reports, and software licenses per the following schedule:

Division 26

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<th>TITLE</th>
<th>Report Data</th>
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| Common Work Results for Electrical 260500 - 21 |

C – Product Checklist; D – Device Setting Report; S – Software License
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END SECTION 260500
SECTION 260519 – LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY:
A. This section includes wires, cables, and connectors for power, lighting, signal, control, and related systems rated 600 volts and less.

1.2 QUALITY ASSURANCE:
A. Manufacturers: Firms regularly engaged in manufacture of electrical wire and cable products of types, sizes, and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.
B. Installer's Qualifications: Firm with at least 3 years of successful installation experience with projects utilizing electrical wiring and cabling work similar to that required for this project.
C. Conform to applicable code regulations regarding toxicity of combustion products of insulating materials.

1.3 SUBMITTALS:
A. See Section 26 05 00 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.
B. Product Data: Submit manufacturer's data on electrical wires, cables and connectors.

1.4 DELIVERY, STORAGE, AND HANDLING:
A. Deliver wire and cable properly packaged in factory-fabricated type containers, or wound on NEMA-specified type wire and cable reels.
B. Store wire and cable in clean dry space in original containers. Protect products from weather, damaging fumes, construction debris and traffic.
C. Handle wire and cable carefully to avoid abrading, puncturing and tearing wire and cable insulation and sheathing. Ensure that dielectric resistance integrity of wires/cables is maintained.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:
A. Manufacturers: Subject to compliance with requirements, provide products by the following (for each type of wire, cable, and connector):
   1. Wire and Cable:
a. American Insulated Wire
b. Belden
c. General Cable Corporation.
d. Okonite
e. Superior Essex:
   1) Triangle

2. Connectors:
   a. O-Z/Gedney Co.
   b. AMP, Inc.
   c. Burndy Corporation.
   d. Ideal Industries, Inc.
   e. 3M Company
   f. Thomas and Betts Corp.

2.2 WIRES AND CABLES:

A. General: Provide wire and cable suitable for the temperature, conditions, and location where installed.

B. Conductors: Provide solid conductors and approved connectors for power, control, and lighting circuits 12 AWG and smaller. Provide stranded conductors for 10 AWG and larger.

C. Conductor Material: Provide copper for all wires and cables.

   1. Portable Cord:
      a. Type SO: Sizes 12 AWG through 2 AWG, copper conductors with 600 volt thermoset insulation 0.1 resistant insulation.
      b. Type G-GC: Sizes 1 AWG through 500 KCMIL, copper conductors with 600/2000 volt, 90 degrees C, ethylene-propylene insulation.

   2. Cables: Provide the following types of cables in NEC approved locations and applications where permitted by the contract documents. Cables shall be U.L. listed and approved by the local building authority. All cables shall contain a green insulated equipment ground conductor of the same size as the neutral conductor.

2.3 CONNECTORS:

A. Description: Provide UL-type factory-fabricated, solderless metal connectors of sizes, ampacity ratings, materials, types and classes for applications and for services indicated. Use connectors with temperatures equal to or greater than those of the wires upon which used.

B. Provide 2-hole compression lugs for all power feeder, neutral, and grounding connections when installed on bus bars. (Including phase, neutral and grounding conductors).

C. Provide connectors that are designed to accept stranded conductors where stranded conductors are used.
PART 3 - EXECUTION

3.1 WIRE AND CABLE INSTALLATION SCHEDULE:

A. Building Wire: Install all building wire in raceway regardless of location.

B. Metal Clad Cable:

1. Maximum of 6 feet unsupported length for connecting luminaires in accessible ceilings to the local junction box.
2. Maximum of 6 feet unsupported length for connecting luminaires in non-accessible ceilings to the local junction box.
3. In casework for horizontal branch circuit runs between devices.
4. May not be used for branch circuit home runs, feeders, motor feeder circuits or in the following locations:
   a. Hazardous locations
   b. Emergency Systems
5. Branch circuit conductors shall match color coding schedule within this specification section.

C. Portable Cord: Use for flexible pendant leads to luminaires, outlets, and equipment where indicated and in compliance with codes.

3.2 INSTALLATION OF WIRES AND CABLES:

A. General: Install electrical cables, wires and connectors in compliance with applicable requirements of NEC, NEMA, UL, and NECA's "Standard of Installation", and in accordance with recognized industry practices.

B. Coordinate wire/cable installation work, including electrical raceway and equipment connection work, with other work.

C. Pull conductors simultaneously where more than one is being installed in same raceway. Use pulling compound or lubricant, where necessary; compound used must not deteriorate conductor or insulation.

D. Use pulling means including, fish tape, cable, rope and basket weave wire/cable grips which will not damage cables or raceway. Do not use rope hitches for pulling attachment to wire or cable.

E. Keep conductor splices to minimum. Splice only in accessible junction boxes. No splices are allowed in feeder, control or fire alarm wiring. Connect unspliced wire to numbered terminal strips at each end.

F. Install splices and taps which possess equivalent or better mechanical strength and insulation ratings than conductors being spliced.

G. Use splice and tap connectors which are compatible with conductor material.
H. Tighten electrical connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Std. 486A for copper and 486B for aluminum.

I. Support cables above accessible ceilings. Independent from the ceiling suspension system to support cables from structure, do not rest on ceiling tiles.

J. Provide adequate length of conductors within electrical enclosures and train the conductors to terminal points with no excess. Bundle multiple conductors, with conductors larger than No. 10 AWG cabled to individual circuits. Make terminations so there is no bare conductor at the terminal.

K. For 8 AWG and smaller, use insulated screw on type spring wire connectors with plastic caps, push on type are not acceptable.

L. Use copper compression connectors for copper wire splices and taps, 6 AWG and larger. Tape uninsulated conductors and connectors with electrical tape to 150 percent of the insulation value of the conductor.

M. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.

N. Thoroughly tape the ends of spare conductors in boxes and cabinets.

O. Install exposed cable, parallel and perpendicular to surfaces, or exposed structural members, and follow surface contours, where possible.

P. Make all ground, neutral and line connections to receptacle and wiring device terminals as recommended by manufacturer. Provide ground jumper from outlet box to individual ground terminal of devices.

Q. Branch circuits whose length from panel to first outlet exceeds 100 feet for 120 volt circuits or 175 feet for 277 volt circuit shall be #10 or larger, as required to comply with the National Electrical Code.

R. Parallel conductors shall be cut to the same length.

S. All splices in control panels, terminal junction boxes, low voltage control circuits, fire alarm, etc., conductors shall be on numbered terminal strip.

T. Where conduit is not required, plenum rated cable shall be provided in ceiling, floor or other air plenum spaces.

U. Provide wire training, lacing, labeling, and terminal blocks as required in panelboards and all control cabinets including, but not limited to, lighting, transfer switch, fire alarm, and security cabinets. All wiring shall be installed neat and be labeled to match wiring diagrams, control devices, etc.
1. Make temporary connections to panelboard devices with sufficient slack conductor to facilitate reconnections required for balancing loads between phases.

V. Color coding of switch leg shall be pink. Color of travelers shall be purple.

3.3 FIELD QUALITY CONTROL:

A. Test installed wires and cables with 1000 VDC megohm meter to determine insulation resistance levels to ensure requirements are fulfilled. Test shall be made on all feeders regardless of size and on all branch circuits with No. 4 AWG and larger conductors. The megger values obtained shall be compared to the minimum values listed in NETA. All phase conductors and cables shall be meggered after installation, and prior to termination. Submit test report.

B. Prior to energization, test wires and cables for electrical continuity and for short-circuits.

C. Subsequent to wire and cable hook-ups, energize circuitry and demonstrate functioning in accordance with requirements. Where necessary, correct malfunctioning units, and then retest to demonstrate compliance.

3.4 COLOR CODING SCHEDULE:

A. Color code secondary service, feeder, and branch circuit conductors as follows:

<table>
<thead>
<tr>
<th>120/208 Volts</th>
<th>Phase</th>
<th>277/480 Volts</th>
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</thead>
<tbody>
<tr>
<td>Black</td>
<td>A</td>
<td>Brown</td>
</tr>
<tr>
<td>Red</td>
<td>B</td>
<td>Orange</td>
</tr>
<tr>
<td>Blue</td>
<td>C</td>
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</tr>
<tr>
<td>White</td>
<td>Neutral</td>
<td>Gray</td>
</tr>
<tr>
<td>Green</td>
<td>Ground</td>
<td>Green</td>
</tr>
</tbody>
</table>

B. Conductors shall be solid color for entire length.

C. If solid color conductor insulation is not available and specific acceptance is given by the engineer for use of black conductor insulation, provide the following:

1. Conductors 10 AWG and smaller shall be solid color for the entire length.
2. Conductors 8 AWG and larger shall have either solid color insulation as specified above for the entire length or be black with color coding at each termination and in each box or enclosure. For a distance of 6 inches use half-lapped ¾ inch plastic tape in the above specified color. Do not cover cable identification markings. Adjust tape locations to prevent covering of markings.

3.5 METAL CLAD WIRING INSTALLATION:

A. The location of system components are approximate. Use good judgment in their placement to eliminate all interference with ducts, piping, etc.
B. All cable routing shall be done in a neat and workmanlike manner, consistent with recognized good practice and in accordance with the manufacturer's instructions.

C. Route the cables along the grid system. Do not route cables diagonally or in any way which restricts removal of lay-in ceiling material.

D. Support cable on ceiling wires adjacent to each luminaire and at four foot intervals using clamp supports manufactured specifically for that purpose.

END OF SECTION 260519
SECTION 260526 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY:
A. This Section includes solid grounding of electrical systems and equipment. It includes basic requirements for grounding for protection of life, equipment, circuits, and systems. Grounding requirements specified in this Section may be supplemented in other sections of these Specifications.

1.2 SUBMITTALS:
A. See Section 26 05 00 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.
B. Product data for connectors and connection materials, and grounding fittings.

1.3 QUALITY ASSURANCE:
A. Listing and Labeling: Provide products specified in this Section that are listed and labeled. The terms "listed" and "labeled" shall be defined as they are in the National Electrical Code, Article 100.
B. Manufacturer's Qualifications: Firms regularly engaged in manufacture of grounding and bonding products, of types, and ratings required, and ancillary grounding materials, including stranded cable, copper braid and bus, grounding electrodes and plate electrodes, and bonding jumpers whose products have been in satisfactory use in similar service for not less than 5 years.
C. Installer's Qualifications: Firm with at least 3 years of successful installation experience on projects with electrical grounding work similar to that required for project.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:
A. Manufacturers: Subject to compliance with requirements, provide products by the following:
   1. Burndy Corporation
   2. Cadweld Div.; Erico Products Inc.
   3. Ideal Industries
   4. OZ Gedney Div.
   5. Thermoweld
   6. Thomas and Betts Corp.
2.2 GROUNDING AND BONDING PRODUCTS:
   A. Products: Of types indicated and of sizes and ratings to comply with NEC. Where types, sizes, ratings, and quantities indicated are in excess of NEC requirements, the more stringent requirements and the greater size, rating, and quantity indications govern.
   B. Conductor Materials: Copper.

2.3 WIRE AND CABLE CONDUCTORS:
   A. General: Comply with Division 26 Section on Wires and Cables. Conform to NEC, except as otherwise indicated, for conductor properties, including stranding.
   B. Equipment Grounding Conductor: Green insulated.
   C. Grounding Electrode Conductor: Stranded cable.
   D. Bare Copper Conductors: Conform to the following:
      1. Solid Conductors: ASTM B-3
      2. Assembly of Stranded Conductors: ASTM B-8
      3. Tinned Conductors: ASTM B-33

2.4 MISCELLANEOUS CONDUCTORS:
   A. Ground Bus: Bare annealed copper bars of rectangular cross section.
   B. Braided Bonding Jumpers: Copper tape, braided No. 30 gage bare copper wire, terminated with copper ferrules.
   C. Bonding Strap Conductor/Connectors: Soft copper, 0.05 inch thick and 2 inches wide, except as indicated.

2.5 CONNECTOR PRODUCTS:
   A. General: Listed and labeled as grounding connectors for the materials used.
   B. Pressure Connectors: High-conductivity-plated units.
   C. Bolted Clamps: Heavy-duty units listed for the application.
   D. Exothermic Welded Connections: Provided in kit form and selected for the specific types, sizes, and combinations of conductors and other items to be connected.

PART 3 - EXECUTION

3.1 APPLICATION:
   A. Equipment Grounding Conductor Application: Comply with NEC for sizes and quantities of equipment grounding conductors, except where larger sizes or more conductors are indicated.
1. Install separate insulated equipment grounding conductors with circuit conductors for the following in addition to those locations where required by Code:
   a. Feeders and branch circuits.

2. Laboratory Panel Circuits: Install separate insulated equipment ground wire in branch circuits from laboratory area power panels.

B. All systems shall be grounded in accordance with the NEC.

3.2 INSTALLATION:

A. General: Ground electrical systems and equipment in accordance with NEC requirements except where the Drawings or Specifications exceed NEC requirements. Connect together system neutral, service equipment enclosures, exposed noncurrent carrying metal parts of electrical equipment, metal raceway systems, grounding conductor in raceways and cables, receptacle ground connectors, and plumbing systems.

B. Route grounding conductors along the shortest and straightest paths possible without obstructing access or placing conductors where they may be subjected to strain, impact, or damage, except as indicated.

C. Labeling: Provide a phenolic tag for all grounding electrode conductors as described in section on Electrical Identification.

D. Where grounding conductors, grounding electrode conductors, or bonding conductors are non-exposed, identify each with a 6-inch band of green tape at each end and at 10 foot intervals. When run in conduits, provide color banding on conduit per section on Electrical Identification.

3.3 CONNECTIONS:

A. General: Make connections in such a manner as to minimize possibility of galvanic action or electrolysis. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

1. Use electroplated or hot-tin-coated materials to assure high conductivity and make contact points closer in order of galvanic series.
2. Make connections with clean bare metal at points of contact.
3. Coat and seal connections involving dissimilar metals with inert material such as red lead paint to prevent future penetration of moisture to contact surfaces.

B. Terminate insulated equipment grounding conductors for feeders and branch circuits with pressure-type grounding lugs. Where metallic raceways terminate at metallic housings without mechanical and electrical connection to the housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to the ground bus in the housing. Bond electrically non-continuous conduits at both entrances and exits with grounding bushings and bare grounding conductors. Terminate each conductor on an individual ground lug terminal.

C. Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts.
Where manufacturer's torqueing requirements are not indicated, tighten connections to comply with torque tightening values specified in UL 486A.

D. Compression-Type Connections: Use hydraulic compression tools to provide the correct circumferential pressure for compression connectors. Use tools and dies recommended by the manufacturer of the connectors. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on the ground conductor.

E. Moisture Protection: Where insulated ground conductors are connected to ground rods or ground buses, insulate the entire area of the connection and seal against moisture penetration of the insulation and cable.

3.4 FIELD QUALITY CONTROL:

A. Upon completion of installation of electrical grounding and bonding systems, test ground resistance with ground resistance tester. Where tests show resistance-to-ground is over 5 ohms, take appropriate action to reduce resistance to 5 ohms, or less, by driving additional ground rods; then retest to demonstrate compliance.

B. Ground Resistance Test:

1. Grounding electrode resistance testing shall be accomplished with a ground resistance direct-reading single test meter utilizing the fall-of-potential method and two reference electrodes. Perform test prior to interconnection to other grounding systems. Orient the ground electrode to be tested and the two reference electrodes in a straight line spaced fifty (50) feet apart. Drive the two reference electrodes five (5) feet deep.

C. Correct Deficiencies, Retest and Report:

1. Correct unsatisfactory conditions and retest to demonstrate compliance; replace conductors, units and rods as required to bring system into compliance.
2. Prepare a written report and show temperature, humidity and condition of soil at time of tests. Report shall be certified by testing agency that identifies components checked and describes results. Include notation of deficiencies detected, remedial action taken, and observations and test results after remedial action.

3.5 CLEANING AND ADJUSTING:

A. Restore surface features at areas disturbed by excavation and reestablish original grades except as otherwise indicated. Where sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other Work to their original condition. Include necessary top-soiling, fertilizing, liming, seeding, sodding, sprigging, or mulching. Restore vegetation and disturbed paving to original condition.

END OF SECTION 260526
SECTION 260529 – HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes secure support from the building structure for electrical items by means of hangers, supports, anchors, sleeves, inserts, seals, and associated fastenings.

1.2 SUBMITTALS:

A. See Section 26 05 00 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.

B. Product data for each type of product specified.

1. Hanger and support schedule showing manufacturer's figure number, size, spacing, features, and application for each required type of hanger, support, sleeve, seal, and fastener to be used.

C. Engineered Design consisting of details and engineering analysis for supports for the following items:

1. Suspended transformers
2. Cable trays
3. Trapeze hangers for multiple conduit runs.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Slotted Metal Angle and U-Channel Systems:
   a. Allied Tube & Conduit
   b. B-Line Systems, Inc.
   c. Unistrut Diversified Products

2. Conduit Sealing Bushings:
   a. O-Z/Gedney
   b. Cooper Industries, Inc.
   d. Madison Equipment Co.
   e. Raco, Inc.
   f. Spring City Electrical Mfg. Co.
   g. Thomas & Betts Corp.
2.2  COATINGS:

A. Coating: Supports, support hardware, and fasteners shall be protected with zinc coating or with treatment of equivalent corrosion resistance using approved alternative treatment, finish, or inherent material characteristic. Products for use outdoors shall be hot-dip galvanized.

2.3  MANUFACTURED SUPPORTING DEVICES:

A. Raceway Supports: Clevis hangers, riser clamps, conduit straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring steel clamps.

B. Fasteners: Types, materials, and construction features as follows:

1. Expansion Anchors: Carbon steel wedge or sleeve type.
2. Toggle Bolts: All steel springhead type.

C. Conduit Sealing Bushings: Factory-fabricated watertight conduit sealing bushing assemblies suitable for sealing around conduit, or tubing passing through concrete floors and walls. Construct seals with steel sleeve, malleable iron body, neoprene sealing grommets or rings, metal pressure rings, pressure clamps, and cap screws.

D. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for non-armored electrical cables in riser conduits. Provide plugs with number and size of conductor gripping holes as required to suit individual risers. Construct body of malleable-iron casting with hot-dip galvanized finish.

E. U-Channel Systems: 16-gage steel channels, with 9/16 inch-diameter holes, at a minimum of 8 inches on center, in top surface. Provide fittings and accessories that mate and match with U-channel and are of the same manufacture.

F. Supports: Provide supporting devices of types, sizes and materials indicated; and having the following construction features:

1. One-Hole Conduit Straps: For supporting ¾ inch and smaller rigid metal conduit; galvanized steel.
2. Two-Hole Conduit Straps: For supporting 1 inch and larger rigid metal conduit, galvanized steel; ¾ inch strap width; and 2-1/8 inch between center of screw holes.

2.4  FABRICATED SUPPORTING DEVICES:

A. General: Shop- or field-fabricated supports or manufactured supports assembled from U-channel components.

B. Steel Brackets: Fabricated of angles, channels, and other standard structural shapes. Connect with welds and machine bolts to form rigid supports.

C. Pipe Sleeves: Provide pipe sleeves of one of the following:

1. Steel Pipe: Fabricate from Schedule 40 galvanized steel pipe.
2. EMT, IMC, or Rigid Conduit.
2.5 FIRE SEALS:

A. Material: Fire stopping material shall be asbestos free, 100 percent intumescent, have code approval under BOCA, ICBO, SSBC, NFPA 101, NFPA 70, and be capable of maintaining an effective barrier against flame and gases in compliance with the following requirements.

B. Flame Spread: 25 or less, ASTM E84

C. Fire Resistance and Hose Stream Tests: Fire stopping materials shall be rated "F" and "T" in accordance with ASTM E 814 or UL 1479. Rating periods shall conform to the following:

   (F) 3 (T) 3 Time-rated floor or wall assemblies.

   (F) 3 (T) 3 Openings between floor slabs and curtain wall.

D. Manufacturers: Subject to compliance with requirements, provide fire seals of the following:

   1. 3M Company
   2. STI
   3. Tremco
   4. Hilti

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install supporting devices to fasten electrical components securely and permanently in accordance with NEC requirements.

B. Coordinate with the building structural system and with other electrical installation.

C. Junction Box Supports: Comply with the NEC and the following requirement:

   1. Use ¼" all-thread rod from structure to support junction boxes.

D. Raceway Supports: Comply with the NEC and the following requirements:

   1. Conform to manufacturer's recommendations for selection and installation of supports.
   2. Strength of each support shall be adequate to carry present and future load multiplied by a safety factor of at least four. Where this determination results in a safety allowance of less than 200 lbs., provide additional strength until there is a minimum of 200 lbs. safety allowance in the strength of each support.
   3. Install individual and multiple (trapeze) raceway hangers and riser clamps as necessary to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.
   4. Use #9 ceiling wire to support individual conduits up to 3/4inch with spring steel fasteners. Use of ceiling support wires is unacceptable.
   5. Support parallel runs of horizontal raceways together on trapeze-type hangers. Use 3/8 inch diameter or larger threaded steel rods for support.
   6. Support individual horizontal raceways by separate pipe hangers. Spring steel fasteners may be used in lieu of hangers only for 1-1/2 inch and smaller raceways serving lighting
and receptacle branch circuits above suspended ceilings only. For hanger rods with spring steel fasteners, use ¼ inch-diameter or larger threaded steel. Use spring steel fasteners that are specifically designed for supporting single conduits or tubing. For hanger rods supporting 1-1/2 inch or larger conduits provide 3/8 inch minimum threaded steel rods with pipe hangers.

7. Space supports for raceways in accordance with NEC. When there are 4 or more 2 inch conduits in a trapeze, supports shall be spaced 5 feet O.C.
8. In all runs, arrange support so the load produced by the weight of the raceway and the enclosed conductors is carried entirely by the conduit supports with no weight load on raceway terminals.
9. Threaded rod supports to have bottoms cut off at a maximum length equal to rod diameter below bottom nut.

E. Conductor or Cable Supports: Comply with the NEC and the following requirements:

1. Support individual conductors or cables by separate clamps with rubber or plastic grommet, fasten using a non-metallic bolt and nut, and secure clamps to unistrut supports anchored to structure (multiple clamps may be secured to a single unistrut support). Individual conductors or cables may be served utilizing a vinyl or fiberglass clamp which shall be anchored to the structure.
2. Space supports as follows:
   a. Horizontal conductors not more than 3 feet o.c.
   b. Vertical conductors not more than 5 feet o.c.
3. Install simultaneously with installation of conductors.
4. MC Cable shall be supported by UL listed clip or clamp. Cable tie support is not acceptable.

F. Miscellaneous Supports: Support miscellaneous electrical components separately and as required to produce the same structural safety factors as specified for raceway supports. Install metal channel racks for mounting cabinets, panelboards, disconnects, control enclosures, pull boxes, junction boxes, transformers, and other devices.

G. In overhead spaces, support metal boxes directly from the building structure via 1/4" minimum all-thread or by bar hangers. Where bar hangers are used, attach the bar to raceways on opposite sides of the box and support the raceway with an approved type of fastener not more than 24 inches from the box. Supporting metal boxes utilizing ceiling type wire is not acceptable.

H. Sleeves: Install in concrete slabs and walls and all other fire-rated floors and walls for cable installations as required. Where sleeves through floors are installed, extend above finish floor. For sleeves through fire rated-wall or floor construction, apply UL-listed fire stopping sealant in gaps between sleeves and cables in accordance with "Fire Resistant Joint Sealers" requirement of Division 7 Section "Joint Sealers." See Architectural plans for location and extent of fire rated assemblies.

I. Conduit Seals: Install seals for conduit penetrations of exterior walls below grade. Tighten sleeve seal screws until sealing grommets have expanded to form watertight seal.
J. Fastening: Unless otherwise indicated, fasten electrical items and their supporting hardware securely to the building structure, including but not limited to conduits, raceways, cables, cable trays, busways, cabinets, panelboards, transformers, boxes, disconnect switches, and control components in accordance with the following:

1. Fasten by means of wood screws or screw-type nails on wood, toggle bolts on hollow masonry units, concrete inserts or expansion bolts on concrete or solid masonry, and machine screws, welded threaded studs, or spring-tension clamps on steel. Threaded studs driven by a powder charge and provided with lock washers and nuts may be used instead of expansion bolts and machine or wood screws, where authorized by the Owner and structural engineer. Do not weld conduit, pipe straps, or items other than threaded studs to steel structures. In partitions of light steel construction, use sheet metal screws.

2. Holes cut to depth of more than 1-1/2 inches in reinforced concrete beams or to depth of more than 3/4 inch in concrete shall not cut the main reinforcing bars. Fill holes that are not used.

3. Ensure that the load applied to any fastener does not exceed 25 percent of the proof test load. Use vibration- and shock-resistant fasteners for attachments to concrete slabs.

K. Communication and Telephone Cable Supports: Use No. 9 ceiling wire to support individual or small bundles of cables run above accessible ceilings.

3.2 PERSONNEL PROTECTION:

A. Where U-channel systems, angles, brackets or other standard structural metal shapes are readily accessible and exposed to personnel, provide plastic or rubber end caps.

B. Where threaded rod supports are readily accessible and exposed to personnel, provide plastic or rubber end caps.

3.3 FIRE STOPPING LOCATIONS:

A. Preparation:

1. Coordination: Coordinate the work with other trades. Fire stopping materials at penetrations of insulated pipes and ducts can be applied after insulation is in place. If insulation is composed of combustible material, the thickness of fire stopping materials must be equivalent to that of the insulation. If the insulation is composed of non-combustible material, it may be considered as part of the penetrating item.

2. Surface Preparation: Surface Preparation to be in contact with fire stopping materials shall be free of dirt, grease, oil, loose material or other substances that may affect proper fitting or the required fire resistance.

B. Installation: Install fire stopping materials in accordance with the manufacturer's instructions.

C. Cleaning: After completion of fire stopping work in any area, equipment shall be reviewed and walls, ceilings and all other surfaces shall be cleaned of deposits of firestop materials.

D. Inspection: The architect may select and the Owner will pay an independent testing laboratory to examine fire stopped areas to ensure proper installation prior to concealing or enclosing the fire stopped areas.
END OF SECTION 260529
PART 1 - GENERAL

1.1 SUMMARY:

A. Extent of raceway work is indicated by drawings and schedules. Provide complete conduit systems for all conductors unless otherwise specified.

B. Types of raceways specified in this section include the following:
   1. Electrical metallic tubing (EMT).
   2. Flexible metal conduit.
   3. Intermediate metal conduit (IMC).
   4. Liquid-tight flexible metal conduit.
   5. Rigid metal conduit (RGC).
   6. Wireways.

1.2 QUALITY ASSURANCE:

A. Manufacturers: Firms regularly engaged in manufacture of raceway systems of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Firm with at least 3 years of successful installation experience on projects with electrical raceway work similar to that required for this project.

1.3 SUBMITTALS:

A. See Section 26 05 00 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.

B. Product Data: Submit manufacturer's technical product data, including specifications and installation instructions, for each type of raceway system required. Include data substantiating that materials comply with requirements.

C. Shop Drawings: Submit dimensioned drawings of surface metal raceway systems showing layout of raceways and fittings, spatial relationships to associated equipment, and adjoining raceways, if any. Show connections to electrical power panels and feeders.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Subject to compliance with requirements, provide products by the following:

   1. Rigid Metal Conduit:
      a. Allied
2. Intermediate Metal Conduit (IMC):
   a. Allied

3. EMT Conduit:
   a. Allied
   b. Republic

4. Steel Fittings:
   a. O/Z Gedney
   b. Raco
   c. Appleton

5. Conduit Bodies:
   a. O/Z Gedney
   b. Appleton

2.2 METAL CONDUIT AND TUBING:

A. Rigid Galvanized Steel Conduit (RGC):
   2. Fittings: Threaded galvanized steel, bushings shall have nylon insulated throat.

B. Intermediate Metal Conduit (IMC):
   2. Fittings: Threaded galvanized steel, bushings shall have nylon insulated throat.

C. PVC Externally Coated Rigid Steel Conduit:
   1. Conduit: Rigid steel zinc-coated with external coating of PVC.
   2. Fittings: Threaded galvanized steel with external PVC coating, bushings shall have nylon insulated throat.

D. Electrical Metallic Tubing (EMT):
   2. Fittings: Steel compression fittings for rain-tight and concrete-tight applications. Steel set-screw for all other connections. Set-screw quick fit type for 2-1/2 inches and larger may be used. Bushings shall be threaded and have nylon insulated throat or nylon bushing.

E. Rigid Aluminum Conduit:
   1. Not allowed unless otherwise noted.

F. Flexible Metal Conduit:
1. Conduit: Continuous spiral wound, interlocked, zinc-coated steel, approved for grounding.

2. Fittings: Zinc coated, malleable iron. Straight connector shall be one-piece body, female end with clamp and deep slotted machine screw for securing conduit, and threaded male end provided with a locknut. Angle connectors shall be two piece body with removable upper section, female end with clamp and deep slotted machine screw for securing conduit, and threaded male end provided with a locknut. All fittings shall be terminated with threaded bushings having nylon insulated throats.

G. Liquid-Tight Flexible Metal Conduit:

1. Conduit: Continuous spiral wound, interlocked zinc-coated steel with polyvinyl chloride (PVC) jacket, approved for grounding.

2. Fittings: Zinc coated malleable iron. Straight and angle connectors shall be the same as used with flexible metal conduit but shall be provided with a compression type steel ferrule and neoprene gasket sealing rings.

2.3 CONDUIT BODIES:

A. General: Types, shapes and sizes, as required to suit individual applications and NEC requirements. Provide matching gasketed covers secured with corrosion-resistant screws.

B. Metallic Conduit and Tubing: Use malleable iron conduit bodies. Use bodies with threaded hubs for threaded raceways and in hazardous locations.

C. Nonmetallic Conduit: Use nonmetallic conduit bodies.

2.4 WIREWAYS:

A. General: Provide electrical wireways of types, grades, sizes, and number of channels for each type of service as indicated. Provide complete assembly of raceway including, but not limited to, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other components and accessories as required for complete system.

B. Lay-In Wireways: Construct lay-in wireways with hinged covers in accordance with UL 870 with components UL listed. Construct units to be capable of sealing cover in closed position with sealing wire.

1. Connectors: Provide wireway connectors suitable for "lay-in" conductors, with connector covers permanently attached so that removal is not necessary to utilize the lay-in feature.

2. Finish: Protect sheet metal parts with rust inhibiting coating and baked enamel finish. Plate finish hardware to prevent corrosion. Protect screws installed toward inside of wireway with spring nuts to prevent wire insulation damage.

2.5 CONDUIT SIZES:

A. Conduit sizes shall be as shown on the drawings. If the conduit size is not given on the drawings, the conduit shall be sized in accordance with NEC based on the number of conductors enclosed plus a parity sized equipment ground conductor and be subject to the following minimum sizes:
1. Rigid, Intermediate, and EMT Conduit: 3/4 inch for all runs except lighting switch legs, 277 volt lighting branch circuits, temperature control and fire alarm which may be 1/2 inch.
2. Flexible and Liquid-Tight Flexible Conduit: 1/2 inch for all runs.
3. MC Cable: 3/8 inch to under-counter luminaires, 1/2 inch for all other runs.
4. Conduits used for home runs shall contain only the conductors for the circuits indicated on the drawings. Combining multiple home runs into a single conduit will not be permitted.

2.6 RACEWAY SEALING COMPOUND:
A. Non-hardening, safe for human skin contact, not deleterious to cable insulation, workable at temperatures as low as 35 deg. F (1 deg. C), withstands temperature of 300 deg. F (149 deg. C) without slump, and adheres to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials and the common metals.

PART 3 - EXECUTION

3.1 INSPECTION:
A. Examine areas and conditions under which raceways are to be installed, and substrate which will support raceways. Notify Contractor in writing of conditions detrimental to proper completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 CONDUIT SCHEDULE:
A. Raceways in locations subject to mechanical injury: Rigid steel galvanized conduit or intermediate metal conduit. Locations subject to mechanical injury include, but are not limited to, the following:
   1. Exposed conduits in dock areas and high/medium bay locations up to 25 feet above finished floor.
   2. Exposed conduits in parking garages.
   3. Exposed conduits in a Fire Pump Room.
   4. Exposed service entrance feeders.
B. Motor and equipment connections: PVC jacketed liquid-tight flexible metallic conduit with liquid tight connectors.
C. Raceways in all other areas shall be electrical metallic tubing unless otherwise noted.
D. Use flexible metal conduit inside movable partition wireways, from junction boxes to devices and between devices in casework, from outlet boxes to recessed luminaires, and for "fishing" of existing walls.
E. Emergency/Essential Electrical System Circuits: All emergency and Essential Electrical system circuits shall be run totally in non-flexible metal conduit.
F. Rework or extensions of existing conduit shall include the use of similar materials to the existing conduit type unless otherwise noted.

G. BSL2 and BSL3 Level Spaces: Rigid steel galvanized conduit or Intermediate metal galvanized conduit.

3.3 INSTALLATION OF CONDUITS:

A. General: Install electrical raceways in accordance with manufacturer's written installation instruction, applicable requirements of NEC, and as follows:

1. Conceal all conduits unless indicated otherwise, within finished walls, ceilings, and floors. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot water pipes. Install raceways level and square and at proper elevations.

2. Elevation of Raceway:
   a. Where horizontal raceway is installed near water and steam piping, route raceway above piping and as close to structure as possible and practical.
   b. Route raceway as close to structure as possible.

3. Complete installation of electrical raceways before starting installation of conductors within raceways.

4. Provide supports for raceways as specified elsewhere in Division 26.

5. Prevent foreign matter from entering raceways by using temporary closure protection.

6. Protect stub-ups from damage where conduits rise from floor slabs. Arrange so curved portion of bend is not visible above the finished slab.

7. Make bends and offsets so the inside diameter is not effectively reduced. Unless otherwise indicated, keep the legs of a bend in the same plane and the straight legs of offsets parallel.

8. Use raceway fittings that are types compatible with the associated raceway and suitable for the use and location. Install expansion fittings across all structural construction joints and expansion/deflection couplings across all structural expansion joints.

9. Run raceways parallel and perpendicular to building elements and other equipment with a minimum of bends in the shortest practical distance considering the type of building construction and obstructions except as otherwise indicated.

10. Install exposed raceways parallel and perpendicular to nearby surfaces or structural members and follow the surface contours as much as practical.

11. Install vertical feeder conduits in exterior walls, core walls, or chase spaces. Do not install in interior wall partition areas.

12. Run exposed and parallel raceways together. Make bends in parallel runs from the same center line so that the bends are parallel. Factory elbows may be used only where they can be installed parallel. In other cases provide field bends for parallel raceways.

13. Make raceway joints tight. Where joints cannot be made tight, use bonding jumpers to provide electrical continuity of the raceway system. Make raceway terminations tight. Where terminations are subject to vibration, use bonding bushings or wedges to assure electrical continuity. Where subject to vibration or dampness, use insulating bushings to protect conductors. Joints in non-metallic conduits shall be made with solvent cement in strict accordance with manufacturer's recommendations.

14. Tighten set screws of thread less fittings with suitable tool.

15. Terminations: Where raceways are terminated with locknuts and bushings, align the raceway to enter squarely and install the locknuts with dished part against the box. RGC
and IMC shall be secured with double locknuts and an insulated metallic bushing. EMT shall be secured with one locknut and shall have nylon insulated throats or threaded nylon bushings from 1/2" to 1". 1-1/4" and above shall be metal with nylon insulated throats. Use grounding type bushings for feeder conduits at switchboards, panelboards, pull boxes, transformers, motor control centers, VFD's, etc.

16. Where terminating in threaded hubs, screw the raceway or fitting tight into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align the raceway so the coupling is square to the box, and tighten the chase nipple so no threads are exposed.

17. Provide nylon pull string with printed footage indicators having not less than 200 pounds tensile strength. Leave not less than 12 inches of slack at each end of the pull string. Identify with tags at each end the origin and destination of each empty conduit and indicate same on all empty or spare conduits on the as-built drawings.

18. Telephone and Signal System Raceways: Install raceways with maximum lengths at 100 feet and with a maximum of two, 90 degrees radiused bends or equivalent. Install 2' x 2' pull boxes where necessary to comply with these requirements. Install long sweep bends for all data and voice raceways.

19. Install raceway sealing fittings in accordance with the manufacturer's written instructions. Locate fittings at suitable, approved, accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points and elsewhere as indicated:

   a. Where conduits enter or leave hazardous locations.
   b. Where conduits pass from warm locations to cold locations, such as the boundaries of refrigerated spaces and air-conditioned spaces.
   c. Where conduits enter through a foundation wall or stub-up through a slab on grade floor.
   d. Where required by the NEC.

20. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment with an adjustable top or coupling threaded inside for plugs and set flush with the finished floor. Extend conductors to equipment with rigid steel conduit; flexible metal conduit may be used 6 inches above the floor. Where equipment connections are not made under this contract, install screwdriver-operated threaded plugs flush with floor.

21. Flexible Connections: Use short length (maximum of 6 feet) of flexible conduit for recessed and semi-recessed luminaires, for equipment subject to vibration, noise transmission, or movement; and for all motors. Use liquid-tight flexible conduit in wet locations. Install separate ground conductor across flexible connections.

22. PVC externally coated rigid steel conduit: Patch all nicks and scrapes in PVC coating after installing conduit.

23. Where conduits are to be installed through structural framing members, the Contractor shall provide sleeves. The Architect/Engineer's written approval must be obtained prior to cutting, notching or drilling of structural framing members.

24. Ream the ends of all cut and/or threaded conduit. Ends shall be cut square.

25. Use of running threads for rigid or intermediate metallic conduit are not permitted. When threaded couplings cannot be used, provide 3 piece union or solid coupling.

26. Conduit stub-ups from below grade or thru the slab shall be PVC coated or PVC taped rigid steel galvanized conduit and shall extend 6 inches above grade.

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS 260533 - 6
27. Wherever conduits enter a structure through a foundation or basement wall below grade, grout around the conduit with water-proof grout or install entrance seals. Seals shall be OZ Type WS or approved equivalent for new construction and OZ type CSM Series for existing structures.

28. Conduits shall not cross pipe shafts or ventilation duct openings. Where conduits must penetrate air-tight spaces or plenums, seal around the conduit with a mastic acceptable to the Architect/Engineer.

29. Install an insulated ground conductor in all conduits.

30. Where individual conduits penetrate existing fire-rated walls and floors, pack void around conduit with fire rated insulation and seal opening around conduit with UL listed foamed silicone elastomer compound. Where conduits penetrate exterior walls, new floors, or roof, provide pipe sleeve one size larger than conduit, pack void around conduit with fire rated insulation, and seal opening around conduit with UL listed foam silicone elastomer compound.

31. Where conduit sleeves penetrate fire rated floors or walls for installation of system cables, AC or MC cables, or modular wiring cables pack void around cables or empty sleeve with fire rated insulation and fill ends with fire-resistive compound. Seal opening around sleeve with UL listed foam silicone elastomer compound.

32. Use PVC-coated rigid steel or Fiberglass factory elbows for bends in plastic conduit runs longer than 100 feet, or in plastic conduit runs which have more than two bends regardless of length. Use long sweep bends for wiring larger than 350 mcm.

33. Wipe plastic conduit clean and dry before joining. Apply full even coat of cement to entire area that will be inserted into fitting. Let joint cure for 20 minutes minimum.

34. No PVC conduit shall be run exposed or inside stud or masonry walls unless specifically called for on the drawings. Transition from PVC to metal conduit shall be made below grade.

35. Provide separate raceway systems for each of the following:

   a. Lighting
   b. Power Distribution
   c. Communications and Data
   d. Emergency Systems
      a) Lighting
      b) Power Distribution
   e. Fire Alarm
   f. Temperature Control

36. Paint new exposed conduits to match existing exposed conduits where installed in areas with existing painted conduits or where otherwise indicated.

37. Provide rebar and tie downs for all conduits and conduit racks to be installed with concrete or slurry to prevent conduit “float”.

38. Patient Care Areas: Provide metal conduit systems for all branch circuits in patient care areas.

B. Install labeling as required in Division 26 section - “Electrical Identification”.

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS 260533 - 7
3.4 INSTALLATION OF SURFACE RACEWAYS AND WIREWAYS:

A. Wireways: Mechanically assemble metal enclosures and raceways to form continuous electrical conductor and connect to electrical boxes, fittings and cabinets as to provide effective electrical continuity and rigid mechanical assembly.

1. Where practicable, avoid use of dissimilar metals throughout system to eliminate possibility of electrolysis. Where dissimilar metals are in contact, coat all surfaces with corrosion inhibiting compound before assembling.
2. Install expansion fittings in all raceways wherever structural expansion joints are crossed.
3. Make changes in direction of raceway run with proper fittings, supplied by raceway manufacturer. Field bends of raceway sections are not permitted.
4. Properly support and anchor raceways for their entire length by structural materials. Raceways are not to span any space unsupported.
5. Use boxes as supplied by raceway manufacturer wherever junction, pull or device boxes are required. Standard electrical "handy" boxes, etc., are not permitted for use with surface raceway installations.
6. Install an insulated grounding conductor in all wireways and surface raceways. Bond grounding conductor to all wireways and surface raceways.
7. Paint new exposed surface metal raceway to match adjacent surfaces where raceway is installed in finished areas such as lobbies, corridors, and normally occupied spaces.
8. Surface raceways and wireways are acceptable only where specifically indicated on the drawings. The proposed use of surface raceways and wireways shall be submitted for review by the Engineer prior to installation.
9. Common wireways are not acceptable for convergence of multiple circuits unless specifically indicated on the drawings. The proposed use of a common wireway shall be submitted for review by the Engineer prior to installation.
10. The proposed use of wireways above or below panelboards, switchboards, motor control centers, and other electrical equipment shall be submitted along with a layout drawing for review by the Engineer prior to installation.

3.5 ADJUSTING AND CLEANING:

A. Upon completion of installation of raceways, inspect interiors of raceways; clear all blockages and remove burrs, dirt and construction debris.

END OF SECTION 260533
SECTION 260534 CABINETS, BOXES, AND FITTINGS

PART 1 - GENERAL

1.1 SUMMARY:

A. This section includes cabinets, boxes, and fittings for electrical installations and certain types of electrical fittings not covered in other sections. Types of products specified in this section include:

1. Outlet and device boxes
2. Pull and junction boxes
3. Cabinets
4. Hinged door enclosures
5. Boxes and fittings for hazardous locations

B. Conduit-body-type electrical enclosures and wiring fittings are specified in the Division 26 Section on Raceways.

1.2 DEFINITIONS:

A. Cabinets: An enclosure designed either for surface or for flush mounting and having a frame, or trim in which a door or doors may be mounted.

B. Device Box: An outlet box designed to house a receptacle device or a wiring box designed to house a switch.

C. Enclosure: A box, case, cabinet, or housing for electrical wiring or components.

D. Hinged Door Enclosure: An enclosure designed for surface mounting and having swinging doors or covers secured directly to and telescoping with the walls of the box.

E. Outlet Box: A wiring enclosure where current is taken from a wiring system to supply utilization equipment.

F. Wiring Box: An enclosure designed to provide access to wiring systems or for the mounting of indicating devices or switches for controlling electrical circuits.

1.3 SUBMITTALS:

A. See Section 26 05 00 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.

B. Submit product data for cabinets and enclosures with classification higher than NEMA 1.

C. Shop drawings for floor boxes and boxes, enclosures, and cabinets that are to be shop fabricated (non-stock items). For shop fabricated junction and pull boxes, show accurately scaled views and spatial relationships to adjacent equipment. Show box types, dimensions, and finishes.
PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Cabinets:
   b. Erickson Electrical Equipment Co.
   c. Electric Panelboard, Inc.
   e. Spring City Electrical Mfg. Co.
   f. Square D Co.
   g. Circle AW

2. Boxes and Fittings for Hazardous Locations:
   a. OZ/Gedney.
   b. Cooper Industries, Inc.
   d. Adalet-PLM.
   e. Robroy Industries, Inc.
   f. Spring City Electrical Mfg. Co.
   g. Appleton

2.2 CABINETS, BOXES, AND FITTINGS, GENERAL:

A. Electrical Cabinets, Boxes, and Fittings: Of indicated types, sizes, and NEMA enclosure classes. Where not indicated, provide units of types, sizes, and classes appropriate for the use and location. Provide all items complete with covers and accessories required for the intended use. Provide gaskets for units in damp or wet locations.

2.3 MATERIALS AND FINISHES:

A. Sheet Steel: Flat-rolled, code-gage, galvanized steel.

B. Fasteners for General Use: Corrosion resistant screws and hardware including cadmium and zinc plated items.

C. Fasteners for Damp or Wet Locations: Stainless steel screws and hardware.

D. Cast Metal for Boxes, Enclosures, and Covers; Copper-free aluminum except as otherwise specified.

E. Exterior Finish: Gray baked enamel for items exposed in finished locations except as otherwise indicated.

F. Painted Interior Finish: Where indicated, white baked enamel. Emergency system cabinets and boxes shall be red.
G. Fittings for Boxes, Cabinets, and Enclosures: Conform to UL 514B. Malleable iron or zinc plated steel for conduit hubs, bushings and box connecters.

2.4 METAL OUTLET, DEVICE, AND SMALL WIRING BOXES:

A. General: Conform to UL 514A, "Metallic Outlet Boxes, Electrical," and UL 514B, "Fittings for Conduit and Outlet Boxes." Boxes shall be of type, shape, size, and depth to suit each location and application.

B. Steel Boxes: Conform to NEMA OS 1, "Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports." Boxes shall be sheet steel with stamped knockouts, threaded screw holes and accessories suitable for each location including mounting brackets and straps, cable clamps, exterior rings and fixture studs.

C. Malleable or Cast-Iron Boxes: Iron alloy, waterproof, with threaded raceway entries and features and accessories suitable for each location, including mounting ears, threaded screw holes for devices and closure plugs.

2.5 PULL AND JUNCTION BOXES:

A. General: Comply with UL 50, "Electrical Cabinets and Boxes", for boxes over 100 cubic inches volume. Boxes shall have screwed or bolted on covers of material same as box and shall be of size and shape to suit application.

B. Steel Boxes: Sheet steel with welded seams. Where necessary to provide a rigid assembly, construct with internal structural steel bracing.

C. Hot-Dipped Galvanized Steel Boxes: Sheet steel with welded seams. Where necessary to provide a rigid assembly, construct with internal structural steel bracing. Hot-dip galvanized after fabrication. Cover shall be gasketed.

D. Cast-Aluminum Boxes: Molded of copper free aluminum, with gasketed cover and integral threaded conduit entrances.

E. Malleable or Cast-Iron Boxes: Molded of iron alloy with gasketed cover and integral threaded conduit entrances.

F. Boxes Approved for Classified Locations: Cast metal boxes conforming to UL 886, "Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations," listed and labeled for use in the specific location classification, and with the specific hazardous material encountered. Conduit entrances shall be integral threaded type.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL:

A. Locations: Install items where indicated and where required to suit code requirements and installation conditions.

B. Cap unused knockout holes where blanks have been removed and plug unused conduit hubs.
C. Support and fasten items securely in accordance with Division 26 Section on Supporting Devices.

D. Sizes shall be adequate to meet NEC volume requirements, but in no case smaller than sizes indicated.

E. Remove sharp edges where they may come in contact with wiring or personnel.

3.2 APPLICATIONS:

A. Outlet Boxes and Fittings: Install outlet and device boxes and associated covers and fittings of materials and NEMA types suitable for each location and in conformance with the following requirements:

1. Interior Dry Locations: Sheet steel, NEMA Type 1.
2. Locations Exposed to Weather or Dampness: Cast metal, NEMA type 3R.
3. Wet Locations: NEMA Type 4 enclosures.
5. Hazardous (Classified) Locations: NEMA type listed and labeled for the location and class of hazard indicated.

B. Pull and Junction Boxes: Install pull and junction boxes of materials and NEMA types suitable for each location except as otherwise indicated.

C. Floor Boxes: In slabs on grade and wet locations use NEMA type 4 boxes. At other locations in slabs, use concrete-tight NEMA 1 boxes.

3.3 INSTALLATION OF OUTLET BOXES:

A. Outlets at Windows and Doors: Locate close to window trim. For outlets indicated above doors center outlets above the door opening except as otherwise indicated.

B. Column and Pilaster Locations: Locate outlet boxes for switches and receptacles on columns or pilasters so the centers of the columns are clear for future installation of partitions.

C. Locations in Special Finish Materials: For outlet boxes for receptacles and switches mounted in desks or furniture cabinets or in glazed tile, concrete block, marble, brick, stone or wood walls, use rectangular shaped boxes with square corners and straight sides. Install such boxes without plaster rings. Saw cut all recesses for outlet boxes in exposed masonry walls.

D. Gasketed Boxes: At the following locations use malleable or cast metal, threaded hub type boxes with gasketed weatherproof covers:

1. Exterior locations.
2. Where surface mounted on unfinished walls, columns or pilasters. (Cover gaskets may be omitted in dry locations).
3. Where exposed to moisture laden atmosphere.
4. At food preparation equipment within four ft. of steam connections.
5. Where indicated.
E. Mounting: Mount outlet boxes for switches with the long axis vertical or as indicated. Mount boxes for receptacles vertically, except above counter receptacles to be mounted horizontally. Three or more gang boxes shall be mounted with the long axis horizontal. Locate box covers or device plates so they will not span different types of building finishes either vertically or horizontally. Locate boxes for switches near doors on the side opposite the hinges and close to door trim, even though electrical floor plans may show them on hinge side. Provide far side box supports, for electrical switch boxes installed on metal studs and provide stud to stud support for electrical receptacle boxes installed on metal studs.

F. Ceiling Outlets: For fixtures, where wiring is concealed, use outlet boxes 4 inches square by 1-1/2 inches deep, minimum.

G. Cover Plates for Surface Boxes: Use plates sized to box front without overlap.

H. Protect outlet boxes to prevent entrance of plaster, and debris. Thoroughly clean foreign material from boxes before conductors are installed.

I. Concrete Boxes: Use extra deep boxes to permit side conduit entrance without interfering with reinforcing, but do not use such boxes with over 6 inch depth.

J. Existing Outlet Boxes: Where extension rings are required to be installed, drill new mounting holes in the rings to align with the mounting holes on the existing boxes where existing holes are not aligned.

K. Back to back outlet boxes are not permitted. Separate boxes a minimum of 6 inches in standard walls and 24 inches in acoustical walls.

L. BSL2 and BSL3 Spaces: Use Cast Bell Boxes fully sealed with all threaded connections and seal off fittings in accessible spaces where conduits enter/exit space.

3.4 INSTALLATION OF PULL AND JUNCTION BOXES:

A. Box Selection: For boxes in main feeder conduit runs, use sizes not smaller than 8 inches square by 4 inches deep. Do not exceed 6 entering and 6 leaving raceways in a single box. Quantities of conductors (including equipment grounding conductors) in pull or junction box shall not exceed the following:

<table>
<thead>
<tr>
<th>Size of Largest Conductors in Box</th>
<th>Maximum no. of Conductors in Box</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 4/0 AWG</td>
<td>30</td>
</tr>
<tr>
<td>250 MCM</td>
<td>20</td>
</tr>
<tr>
<td>500 MCM</td>
<td>15</td>
</tr>
<tr>
<td>Over 500 MCM</td>
<td>10</td>
</tr>
</tbody>
</table>

B. Cable Supports: Install clamps, grids, or devices to which cables may be secured. Arrange cables so they may be readily identified. Support cable at least every 30 inches inside boxes.

C. Mount pull boxes in inaccessible ceilings with the covers flush with the finished ceiling.
D. Size: Provide pull and junction boxes for telephone, signal, and other systems at least 50 percent larger than would be required by Article 370 of NEC, or as indicated. Locate boxes strategically and provide shapes to permit easy pulling of future wires or cables of types normal for such systems.

3.5 GROUNDING:

A. Electrically ground metallic cabinets, boxes, and enclosures. Where wiring to item includes a grounding conductor, provide a grounding terminal in the interior of the cabinet, box or enclosure.

3.6 CLEANING AND FINISH REPAIR:

A. Upon completion of installation, inspect components. Remove burrs, dirt, and construction debris and repair damaged finish including chips, scratches, abrasions and weld marks.

B. Galvanized Finish: Repair damage using a zinc-rich paint recommended by the tray manufacturer.

C. Painted Finish: Repair damage using matching corrosion inhibiting touch-up coating.

END OF SECTION 260534
SECTION 260553 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes identification of electrical materials, equipment, and installations. It includes requirements for electrical identification components including but not limited to the following:

1. Identification labeling for raceways, cables, and conductors.
2. Operational instruction signs.
3. Warning and caution signs.
4. Equipment labels and signs.

1.2 SUBMITTALS:

A. See Section 26 05 00 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.

B. Product Data for each type of product specified.

C. Schedule of identification nomenclature to be used for identification signs and labels for each piece of equipment shall include, but not be limited to, the following equipment types as specified in Division 26.

1. Cabinets and enclosures
2. Transformers
3. Panelboards
4. Disconnect switches
5. Circuit breakers and switches
6. Identification required in this section shall apply to equipment furnished in Division 26 and any other applicable Divisions including Division 23.

1.3 QUALITY ASSURANCE:

A. ANSI Compliance: Comply with requirements of ANSI Standard A13.1, "Scheme for the Identification of Piping Systems," with regard to type and size of lettering for raceway and cable labels.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Ideal Industries, Inc.
2. LEM Products, Inc.
3. Markal Corp.
4. Panduit Corp.
2.2 ELECTRICAL IDENTIFICATION PRODUCTS:

A. Identify System Raceways with Painted Couplings & Connectors: Provide painted couplings & connectors for all concealed raceways. Install painted couplings at all conduit connecting couplings including end couplings at stub outs. Refer to UCD Standards for colors.

B. Adhesive Marking Labels for Exposed Raceway and Busway: Pre-printed, flexible, self-adhesive labels with legend indicating voltage and service (Emergency, Lighting, Power, Power D.C., HVAC, Communications, Control, Fire).

1. Label Size for Raceways and Busway: Kroy or Brother Labels 1 inch high by 12 inches long (minimum) with 5/8 inch minimum height letters.

C. Provide colored Adhesive Marking Tape for banding Wires and Cables: Self-adhesive vinyl tape not less than 3 mils thick by 1 inch to 2 inches in width. Make each color band completely encircling cables, at penetrations of walls and floors, at each junction box and at 20-foot maximum intervals in straight runs.

D. Wire/Cable Designation Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound, cable/conductor markers with preprinted numbers and letter.

E. Engraved, Plastic-Laminated Labels, Signs and Instruction Plates: Engraving stock melamine plastic laminate, 1/16 inch minimum thick for signs up to 20 square inches, or 8 inches in length; 1/8 inch thick for larger sizes. Engraved legend in white letters on black face for normal and white letters on red face for emergency, black letters on yellow face for UPS and punched for mechanical fasteners. Where required for ground connections, provide engraved legend in white letters on green face.

F. Fasteners for Plastic-Laminated and Metal Signs: Self-tapping stainless steel screws or number 10/32 stainless steel machine screws with nuts and flat and lock washers.

G. Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking nylon cable ties, 0.18-inch minimum width, 50 lb minimum tensile strength, and suitable for a temperature range from minus 50 degrees F to 350 degrees F. Provide ties in specified colors when used for color coding.

H. Adhesive Marking Tape for Device Cover Plates: 3/8 inch Kroy tape or Brother labels with 3/16 inch minimum height letters. Tape shall have black letters on clear background for normal and red letters on clear background for emergency. Embossed Dymo-Tape labels are not acceptable.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Lettering and Graphics: Coordinate names, abbreviations, colors, and other designations used in electrical identification work with corresponding designations specified or indicated. Install numbers, lettering, and colors as approved in submitals and as required by code.
B. Install identification devices in accordance with manufacturer's written instructions and requirements of NEC.

C. Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work.

D. Conduit Identification: Label conduits with painted couplings & connectors concealed or with labels at 10 foot intervals (medium voltage or exposed) to identify all conduits run exposed or located above accessible ceilings. Conduits located above non-accessible ceiling or in floors and walls shall be labeled within 3 feet of becoming accessible. Labels for multiple conduits shall be aligned and read the same direction. Use the colors as identified above:

E. Identify Junction, Pull and Connection Boxes: Identification of systems and circuits shall indicate system voltage and identity of contained circuits on outside of box cover. Color code shall be same as conduits for pressure sensitive labels. Use self-adhesive marking tape labels at exposed locations and indelible black marker at concealed boxes. All fire alarm boxes shall have covers painted red. All temperature control boxes shall have covers painted blue.

F. Circuit Identification: Tag or label conductors as follows:
   1. Future Connections: Conductors indicated to be for future connection or connection under another contract with identification indicating source and circuit numbers.
   2. Multiple Circuits: Where multiple branch circuits, control wiring or communications/signal conductors are terminated or spliced in a box or enclosure, label each conductor or cable with circuit number. For control and communications/signal wiring, use wire/cable marking tape at terminations in wiring boxes, troughs and control cabinets. Use consistent letter/number conductor designations throughout on wire/cable marking tapes.
   3. Match identification markings with designations used in panelboards shop drawings, Contract Documents, and similar previously established identification schemes for the facility's electrical installations.

G. Apply warning, caution and instruction signs and stencils as follows:
   1. Install warning, caution or instruction signs where required by NEC, where indicated, or where reasonably required to assure safe operation and maintenance of electrical systems and of the items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment operation. Install butyrate signs with metal backing for outdoor items.
   2. Emergency Operating Signs: Install, where required by NEC, where indicated, or where reasonably required to assure safe operation and maintenance of electrical systems and of the items to which they connect, engraved laminate signs with white legend on red background with minimum 3/8 inch high lettering for emergency instructions on power transfer, load shedding, or other emergency operations.
      a. Provide sign at main service entrance switch, indicating type and location of on-site stand-by generator as required by NEC. Sign shall read “Secondary Source Provided by Engine Generator Located In Room NAME and NUMBER”.

H. Install equipment/system circuit/device identification as follows:
1. Apply equipment identification labels of engraved plastic-laminate on each major unit of electrical equipment in building, including central or master unit of each electrical system. This includes communication/signal/alarm systems, unless unit is specified with its own self-explanatory identification. Text shall match terminology and numbering of the Contract Documents and shop drawings. Apply labels for each unit of the following categories of electrical equipment.

   a. Panelboards, electrical cabinets and enclosures.
   b. Access doors and panels for concealed electrical items.
   c. Control devices.
   d. Transformers.

I. Apply circuit/control/item designation labels of engraved plastic laminate for disconnect switches, breakers, pushbuttons, pilot lights, motor control centers, and similar items for power distribution and control components above, except panelboards and alarm/signal components, where labeling is specified elsewhere.

J. For panelboards, provide framed, typed circuit schedules (label all spares and spaces in pencil) with explicit description and identification of items controlled by each individual breaker.

K. Tag all grounding electrode conductors, associated bonding conductors, and grounding conductors at their point of attachment to any ground bus and grounding electrode (where possible) with a 2 inch diameter round green phenolic nameplate. Lettering shall be 1/4 inch high with 1/5 inch between lines centered on the tag stating "DO NOT DISCONNECT," "MAIN GROUND." Nameplate shall attach to conductor with a short length of small chain.

L. Install labels at locations as required and at locations for best convenience of viewing without interference with operation and maintenance of equipment.

M. Provide tape labels for identification of individual receptacles including receptacles in furniture systems and light switch wall-plates. Locate tape on front of plate and identify panel/branch circuit serving the receptacle. Provide tape labels for identification of individual switches or thermal overload switches which serve as equipment disconnects. Locate the tape on the front of the cover-plate and identify panel/branch circuit serving the equipment.

END OF SECTION 260553
SECTION 260583 – WIRING CONNECTIONS

PART 1 - GENERAL

1.1 SUMMARY:

A. Extent of electrical connections for equipment is indicated by drawings and schedules. Electrical connections are hereby defined to include connections used for providing electrical power to equipment.

B. Applications of electrical power connections specified in this section include the following:
   1. To converters, rectifiers, transformers, inverters, rheostats, and similar current adjustment features of equipment.
   2. To grounds including earthing connections.
   3. From push buttons to equipment requiring electrical connection.
   4. Other connections as shown.

1.2 QUALITY ASSURANCE:

A. Manufacturers: Firms regularly engaged in manufacture of electrical connectors and terminals, of types and ratings required, and ancillary connection materials, including electrical insulating tape, soldering fluxes, and cable ties, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Firms with at least 2 years of successful installation experience with projects utilizing electrical connections for equipment similar to that required for this project.

1.3 SUBMITTALS:

A. See Section 26 05 00 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.

B. Product Data: Submit manufacturer's data on electrical connections for equipment products and materials. All mechanical and plumbing equipment shall be coordinated with unit nameplate information per the actual nameplate to be included on the equipment. As a minimum, information shall include: Operating Voltage; MCA (Min. circuit amperes); FLA (Full load amperes); MFS (Max. fuse size) or MOP (Max. overcurrent protection); and SCCR (Short Circuit Current Rating) and shall match electrical equipment and protection/distribution sizes and be rated for available short circuit currents as shown on the drawings. Bracing for equipment shall be provided at incoming terminals and as an option throughout the equipment for the available fault current or downstream equipment and devices shall be protected by current limiting fuses.

1.4 DEFINITIONS:

A. Load voltage wiring shall be defined as:
1. Conduit and wiring required to carry power to motors and other equipment or devices. Wiring from control devices to equipment that carry power to drive that equipment such as line voltage thermostats, etc., shall be included as load voltage wiring. Wiring that provides power to control panels, control transformers, control relays, time clocks, etc., shall also be included as load voltage wiring.

1.5 DELIVERY, STORAGE, AND HANDLING:

A. Deliver electrical connection products wrapped in proper factory fabricated type containers.

B. Store electrical connection products in original cartons and protect from weather, construction traffic and debris.

C. Handle electrical connection products carefully to prevent breakage, denting, and scoring finish.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Manufacturer: Subject to compliance with requirements, provide circuit and motor disconnects by one of the following:

1. General Electric Co.
2. Eaton
3. Square D Company
5. Westinghouse Electric Corp.

2.2 GENERAL:

A. Overcurrent Protective Devices (OCPDs): Provide type, rating, and features as indicated. Comply with Division 26 Section on Low Voltage Circuit Protective Devices, with OCPDs adapted to equipment connection installation. Tandem circuit breakers shall not be used. Multiple breakers shall have common trip.

B. Provide motor controllers that are horsepower rated to suit the motor controlled.

C. Contacts shall open each ungrounded connection to the motor. Contacts shall be NEMA rated, 75 degrees C.

D. Overload relays shall be ambient-compensated type with inverse-time-current characteristic. Provide with heaters or sensors in each phase matched to nameplate full load current of the specific motor to which connected with appropriate adjustment for duty cycle and power factor correction supplied with the motor.

2.3 MATERIALS AND COMPONENTS:

A. General: For each electrical connection indicated, provide complete assembly of materials, including but not necessarily limited to, pressure connectors, terminals (lugs), electrical insulating tape, electrical solder, electrical soldering flux, heat-shrinkable insulating tubing,
cable ties, solderless wire-nuts, disconnect, starter, contactor, relays, etc., and other items and accessories as needed to complete splices and terminations of types indicated.

B. Metal Conduit, Tubing and Fittings:

1. General: Provide metal conduit, tubing and fittings of types, grades, sizes and weights (wall thicknesses) indicated for each type service. Provide products complying with Division-26 section on Raceways.

C. Wires, Cables, and Connectors:

1. General: Provide wires, cables, and connectors complying with Division-26 section on Wires and Cables.
2. Wires/Cables: Unless otherwise indicated, provide wires/cables (conductors) for electrical connections which match, including sizes, ratings, and material of wires/cables which are supplying electrical power.
3. Connectors and Terminals: Provide electrical connectors and terminals which mate and match, including sizes and ratings, with equipment terminals and are recommended by equipment manufacturer for intended applications.
4. Electrical Connection Accessories: Provide electrical insulating tape, heat-shrinkable insulating tubing and boots, electrical solder, electrical soldering flux, wire-nuts and cable ties as recommended for use by accessories manufacturers for type services indicated.
5. Cord and Plug Connected Equipment: Where indicated, contractors shall provide a length of SO cord complete with a straight blade or twist-lock receptacle for connection of equipment. Cord and plug rating shall be suitable for the connected equipment load and rating of the branch circuit overcurrent protective device. Plug shall match receptacle configuration included on the plans and cord length shall be as required. Contractor shall connect cord to equipment.

2.4 MANUAL MOTOR STARTERS:

A. Manual starters shall be flush-mounting type except where conduits are run exposed or as otherwise noted. Manual starters shall be complete with properly sized overload protection and neon pilot light. Manual starters shall be Square D Class 2510 or Allen-Bradley Bulletin 600 with stainless steel plates.

B. Heater units in all manual motor starters shall be sized for approximately 115 percent of full load motor current. Check and coordinate all thermal protective devices with the equipment they protect.

2.5 CIRCUIT AND MOTOR DISCONNECT SWITCHES:

A. General: Provide circuit and motor disconnect switches in types, sizes, duties, features, ratings, and enclosures as indicated. All equipment with maximum fuse size listed in nameplate shall have fusible disconnect switch provided. Provide NEMA 1 enclosure. For outdoor switches and switches indicated as weatherproof, provide NEMA 3R enclosures with rain-tight hubs. For motor and motor starter disconnects, provide units with horsepower ratings suitable to the loads.
B. Fusible Switches: Provide UL type "HD" 100 percent duty rated switches, with fuses of classes and current ratings indicated. Where current limiting fuses are indicated, provide switches with non-interchangeable feature suitable only for current limiting type fuses. All disconnect switches shall be fusible unless otherwise noted.

C. Non-fusible Disconnects: Provide UL type "HD" 100 percent duty rated switches of classes and current ratings as indicated.

D. Double-Throw Switches: Provide heavy duty switches of classes and current ratings as indicated.

E. Switches for Classified (Hazardous) Locations: Provide heavy duty switches, with UL labels and listings for hazardous location classifications in which installed.

F. Accessories:
   1. Electrical Interlocks: Provide number and arrangement of interlock contacts in switches as indicated or required.
   2. Special Enclosure Material: Provide special enclosure material as follows for switches indicated:
      a. Stainless Steel Type 304: For NEMA Type 4.
      b. Molded Fiberglass Reinforced Plastic: For NEMA Type 4x.
      c. Heavy Cast Aluminum: For hazardous locations. NEMA Types 7 through 9.
   3. Handles shall be lockable in open and closed position without modification.
   4. Disconnect switches provided in the motor feeders between a VFD and the motor shall be provided with auxiliary contacts at the disconnect that de-energizes power to the VFD.

2.6 MOTOR STARTERS:

A. See Division 23 for Requirements

2.7 AUXILIARY CONTROL DEVICES:

1. Built in 120 volts control circuit transformer, fused from line side, where service exceeds 120 volts.

PART 3 - EXECUTION

3.1 INSPECTION:

A. Inspect area and conditions under which electrical connections for equipment are to be installed and notify Contractor in writing of conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.
3.2 INSTALLATION OF ELECTRICAL CONNECTIONS:

A. Furnish, set in place, and wire (except as may be otherwise indicated) all heating, ventilating, air conditioning, plumbing and fire protection, elevator, etc., motors and controls in accordance with the following schedule and in accordance with equipment manufacturer's written instructions and with recognized industry practices, and complying with applicable requirements of UL, NEC and NECA's "Standard of Installation" to ensure that products fulfill requirements. Carefully coordinate with work performed under the Mechanical Division of these Specifications.

B. Coordinate with other work, including wires/cables, raceway and equipment installation, as necessary to properly interface installation of electrical connections for equipment with other work.

C. Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams. Mate and match conductors of electrical connections for proper interface between electrical power supplies and installed equipment.

D. Maintain existing electrical service and feeders to equipment serving occupied areas and operational facilities, unless otherwise indicated, or when authorized otherwise in writing by Owner, or Architect/Engineer. Provide temporary service during interruptions to existing facilities. When necessary, schedule momentary outages for replacing existing wiring systems with new wiring systems. When that "cutting over" has been successfully accomplished, remove, relocate, or abandon existing wiring as indicated.

E. Cover splices with electrical insulating material equivalent to, or of greater insulation resistivity rating, than electrical insulation rating of those conductors being spliced.

F. Prepare cables and wires, by cutting and stripping covering armor, jacket, and insulation properly to ensure uniform and neat appearance where cables and wires are terminated. Exercise care to avoid cutting through tapes which will remain on conductors. Also avoid "ringing" copper conductors while skinning wire.

G. Trim cables and wires as short as practicable and arrange routing to facilitate inspection, testing and maintenance.

H. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturers published torque tightening values for equipment connectors. Accomplish tightening by utilizing proper torqueing tools, including torque screwdriver, beam-type torque wrench, and ratchet wrench with adjustable torque settings. Where manufacturer's torqueing requirements are not available, tighten connectors and terminals to comply with torqueing values contained in UL's 486A.

I. Install pre-finished cord set where connection with attachment plug is indicated or specified, or use attachment plug with suitable strain-relief clamps.

J. Provide suitable strain relief clamps for cord connection to outlet boxes and equipment connection boxes.
K. Make wiring connections in control panel or in wiring compartment of pre-wired equipment and interconnecting wiring in accordance with manufacturer's instructions.

L. Install disconnect switches, controllers, control stations, and control devices such as limit switches and temperature switches as indicated or per manufacturer's instructions.

M. Provide each motor with a fused disconnect switch for 3 phase motors and horsepower rated and/or thermal rated disconnect switch for single phase motors as shown on schedules or required. Coordinate with manufacturers of standalone, packaged and other equipment for factory installed and field installed motors and controllers.

N. Provide circuit and motor disconnect switches as indicated and where required by Code. Comply with switch manufacturers printed installation instructions. Install within sight of motors.

O. All splices in control panels, terminal junction boxes, low voltage control circuits and fire alarm conductors shall be on numbered terminal strip.

P. Each branch circuit serving dedicated, isolated or emergency receptacles, multi-outlet assemblies or equipment connections shall be furnished with a dedicated neutral conductor. Neutrals common to more than one circuit shall only be permitted where specifically noted.

Q. Where conduit is not required, plenum rated cable shall be provided in ceiling, floor or other air plenum spaces.

3.3 FIELD QUALITY CONTROL:

A. Upon completion of installation of electrical connections, and after circuitry has been energized with rated power source, test connections to demonstrate capability and compliance with requirements. Ensure that direction of rotation of each motor fulfills requirement. Correct malfunctioning units at site, then retest to demonstrate compliance.

3.4 EQUIPMENT CONNECTION SCHEDULES:

A. Mechanical Equipment:

1. Refer to Mechanical Equipment Schedule on the drawings.
2. It is suggested that all load voltage wiring shall be provided under Division 26.
3. Unless otherwise indicated, it is suggested that all equipment motors and control shall be furnished, set in place, and wired in accordance with the schedule contained herein. The exact furnishing and installation of the equipment is left to the Contractors involved. Contractor should note that the intent of this schedule is to have the Contractor responsible for coordinating all wiring as outlined, whether or not specifically called for by the Division 23 or Division 26 drawings and specifications. Comply with the applicable requirements of Division 26 for all electrical work which is not otherwise specified. No extras will be allowed for contractor's failure to provide for these required items. Contractor shall refer to the Division 26 and Division 23 specifications and plans for all power and control wiring and shall advise the Architect/Engineer of any discrepancies prior to bidding.
<table>
<thead>
<tr>
<th>ITEM</th>
<th>FURNISHED BY</th>
<th>SET BY</th>
<th>CONTROL WIRING (non-load voltage)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Mechanical Equipment Motors</td>
<td>M</td>
<td>M</td>
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<tr>
<td>2. Special Equipment (i.e., elevators, etc.)</td>
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<td></td>
</tr>
<tr>
<td>a. Motors</td>
<td>G</td>
<td>G</td>
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</tr>
<tr>
<td>b. Magnetic Motor Starters</td>
<td>G</td>
<td>E*</td>
<td>--</td>
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<tr>
<td>c. Disconnect Switches</td>
<td>E</td>
<td>E</td>
<td>--</td>
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<tr>
<td>d. Thermal OL Switches</td>
<td>E</td>
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<tr>
<td>e. Manual Operating Switches</td>
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<tr>
<td>3. Motor Starters, combination motor starter/disconnect and Variable Frequency Drives</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Automatically controlled, with or without HOA switches.</td>
<td>M</td>
<td>E*</td>
<td>M</td>
</tr>
<tr>
<td>b. Manually controlled.</td>
<td>M</td>
<td>E*</td>
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<tr>
<td>c. Starters integral with motor control center including control relays and transformers.</td>
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<td>E</td>
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</tr>
<tr>
<td>d. Combination Starter/Disconnects</td>
<td>M</td>
<td>E*</td>
<td>M</td>
</tr>
<tr>
<td>4. Pushbutton stations, pilot lights</td>
<td>M</td>
<td>E*</td>
<td>M</td>
</tr>
<tr>
<td>5. Disconnect switches, thermal overload switches, manual operating switches.</td>
<td>E</td>
<td>E*</td>
<td>M</td>
</tr>
<tr>
<td>6. Multi-speed switches</td>
<td>M</td>
<td>E*</td>
<td>M</td>
</tr>
<tr>
<td>7. Control relays, transformers.</td>
<td>M</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>8. Load voltage control items such as line voltage thermostats not connected to control panel systems.</td>
<td>M</td>
<td>M</td>
<td>E</td>
</tr>
<tr>
<td>9. Non-load voltage control items.</td>
<td>M</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>10. Electric thermostats, remote bulb thermostats, motor valves, float controls, etc., which are an integral part of mechanical equipment or directly attached to ducts, pipes, etc.</td>
<td>M</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>11. Motor valves, damper motor, solenoid valves, EP and PE switches, VAV box controls, actuators, etc.</td>
<td>M</td>
<td>M</td>
<td>M**</td>
</tr>
<tr>
<td>12. Control circuit outlets</td>
<td>E</td>
<td>E</td>
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</tr>
<tr>
<td>a. Load voltage control items such as line voltage thermostats not connected to control panel systems.</td>
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<td>M</td>
<td>E</td>
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<tr>
<td>b. Non-load voltage control items.</td>
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<tr>
<td>c. Electric thermostats, remote bulb thermostats, motor valves, float controls, etc., which are an integral part of mechanical equipment or directly attached to ducts, pipes, etc.</td>
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<td>M</td>
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<tr>
<td>d. Motor valves, damper motor, solenoid valves, EP and PE switches, VAV box controls, actuators, etc.</td>
<td>M</td>
<td>M</td>
<td>M**</td>
</tr>
<tr>
<td>e. Control circuit outlets</td>
<td>E</td>
<td>E</td>
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</tr>
<tr>
<td>ITEM</td>
<td>FURNISHED BY</td>
<td>SET BY</td>
<td>CONTROL WIRING (non-load voltage)</td>
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<tr>
<td>13. Load voltage control items such as line voltage thermostats not connected to control panel systems.</td>
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<tr>
<td>14. Non-load voltage control items.</td>
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<td>M</td>
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<tr>
<td>15. Electric thermostats, remote bulb thermostats, motor valves, float controls, etc., which are an integral part of mechanical equipment or directly attached to ducts, pipes, etc.</td>
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<td>M</td>
<td>M</td>
</tr>
<tr>
<td>16. Motor valves, damper motor, solenoid valves, EP and PE switches, VAV box controls, actuators, etc.</td>
<td>M</td>
<td>M</td>
<td>M**</td>
</tr>
<tr>
<td>17. Control circuit outlets</td>
<td>E</td>
<td>E</td>
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</tr>
<tr>
<td>18. Load voltage control items such as line voltage thermostats not connected to control panel systems.</td>
<td>M</td>
<td>M</td>
<td>E</td>
</tr>
<tr>
<td>19. Non-load voltage control items.</td>
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<td>M</td>
<td>M</td>
</tr>
<tr>
<td>20. Fire protection controls (Including flow switches)</td>
<td>M</td>
<td>M</td>
<td>M**</td>
</tr>
<tr>
<td>21. Duct smoke detectors, including relays for fan shutdown.</td>
<td>E</td>
<td>M</td>
<td>M**</td>
</tr>
<tr>
<td>22. Temperature Control Panel</td>
<td>M</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>23. Interlocks</td>
<td>M</td>
<td>M</td>
<td>M</td>
</tr>
</tbody>
</table>

G = General, Division 13 or 14  
M = Mechanical, Division 23  
E = Electrical, Division 26

* For factory pre-wired equipment specified under other Divisions, all wiring within the equipment shall be by the manufacturer. All required field wiring between sections or other field connection details for power and/or control shall be clearly identified on shop drawings for contractor installation. Division 26 drawings show the provided electrical characteristics for equipment. Manufacturer's equipment provided under other divisions which varies from what is shown on Division 26 drawings shall be the responsibility of the Contractor to complete and pay for any costs for those variations.

** Fire alarm system control modules and wiring from fire alarm contacts to fire alarm system shall be installed by Fire Alarm system installer and match other components of the system. Refer to Division 28. See details.

*** Integral control wiring under Electrical Division as manufacturer supplied equipment. Control wiring for automatic control portion under Mechanical Division.

4. Owner Furnished Equipment:
   a. Refer to Owner Equipment Schedule on drawings.

5. Laboratory Equipment:
a. Refer to laboratory plan and elevation drawings and equipment Schedules.
b. Prior to beginning rough-in, review manufacturer or installer shop drawings for exact locations of all electrical items and to verify mounting requirements.

END OF SECTION 260583
SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY:

A. The extent of wiring device work is indicated by drawings and schedules. Wiring devices are defined as single discrete units of electrical distribution systems which are intended to carry but not utilize electric energy.

B. Types of electrical wiring devices in this section include the following:

1. Receptacles.
2. Ground-fault circuit interrupters.

1.2 QUALITY ASSURANCE:

A. Manufacturers: Firms regularly engaged in manufacture of electrical wiring devices, of types, sizes, and ratings required, whose products have been in satisfactory use in similar service for not less than 3 years.

B. Installer's Qualifications: Firm with at least 2 years of successful installation experience on projects utilizing wiring devices similar to those required for this project.

C. Listing and Labeling: Provide products that are listed and labeled for their applications and installation conditions and for the environments in which installed.

1. The Terms "Listed" and "Labeled": As defined in the "National Electrical Code", Article 100.
2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

1.3 SUBMITTALS:

A. See Section 26 05 00 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.

B. Samples of device plates for color selection and evaluation of technical features shall be submitted.

1.4 COORDINATION:

A. Wiring Devices for Owner Furnished Equipment: Match devices to plug connectors for Owner-furnished equipment.
PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Manufacturers: Subject to compliance with requirements, provide wiring devices of one of the following:

1. Devices:
   a. Hubbell Inc.
   b. Leviton Mfg. Co.
   c. Pass and Seymour Inc.
   d. Cooper Crouse-Hinds Co.
   e. General Electric Co.

2.2 WIRING DEVICES:

A. Color selection shall be verified with UCD Standards prior to ordering. Devices shall be White. All receptacles and switches connected to circuits served from a generator system shall have a red face.

B. Receptacles:

1. All duplex, single, Isolated Ground, Tamper Resistant, Ground Fault Interrupter (GFCI), and other special receptacles shall be minimum, specification grade commercial series, listed by Underwriter's Laboratories, UL 498 and Federal Specification FS W-C-596, 20 amp, nylon face and have a metal mounting strap with self-grounding and have a hex-head green grounding screw and be side and back wired. Each device shall bear the UL/FS Label. Meet NEMA standards for wiring devices including NEMA WD 1 for general requirements and NEMA WD 6 for dimensional standards.
   a. Each device shall have terminal screws and clamps listed for use with stranded wire. Plug-tail device connections are acceptable.

2. Convenience Receptacle Configuration: Duplex or Single as indicated on the drawings, Type 5-20R.

3. Ground-Fault Interrupter Receptacles: Where indicated or required provide "local reset" auto monitoring “self test” ground-fault circuit interrupters. Provide unit capable of being installed in a 2-3/4" deep outlet box without adapter, grounding type, Class A, Group 1 per UL Standard 943. Provide visual indication of lost protection.

4. Receptacles, Industrial Heavy-Duty: Where indicated or required provide connectors that Conform to NEMA Standard PK 4 "Plugs, Receptacles, and cable Connectors of the Pin and Sleeve Type for Industrial Use."

   b. External Cable Grip: Woven wire mesh type made of high strength galvanized-steel wire strand and matched to cable diameter and with attached provision designed for the corresponding connector.
2.3 WIRING DEVICE ACCESSORIES:

A. Verify color and type with Architect/Engineer prior to ordering. Device color to match Wiring Device Color identified above.

B. Wall-plates: Provide wall-plates for single and combination wiring devices, of types, sizes, and with ganging and cutouts as indicated. Select plates which mate and match wiring devices to which attached. Construct with metal screws for securing plates to devices; screw heads colored to match finish of plates. Identify all wall plates used for receptacles with branch circuit number per requirements of section on Electrical Identification. Provide blank wall plates for all cable, data, telephone and junction and outlet boxes. Where cables are routed through the wall-plate, provide grommets in wall-plate openings to protect cables. Provide plates possessing the following additional construction features:

1. Material and Finish: 0.04" thick, type 302 satin finished stainless steel
2. Material and Finish: 0.04" thick, type 302 satin finished stainless steel for use in unfinished areas, mechanical, and electrical rooms.

C. Weather proof covers: Provide weatherproof junction box with gaskets and cover. Cover shall be rated while in use. Use low profile type covers with UV rated and resistant polycarbonate.

PART 3 - EXECUTION

3.1 INSTALLATION OF WIRING DEVICES:

A. Install wiring devices as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC and in accordance with recognized industry practices to fulfill project requirements.

B. Coordinate with other work, including painting, electrical boxes and wiring work, as necessary to interface installation of wiring devices with other work.

C. Install wiring devices only in electrical boxes which are clean; free from excess building materials, dirt, and debris.

D. Install wiring devices after wiring work is completed.

E. Install wall-plates after painting work is completed.

F. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for wiring devices. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Stds. 486A.

G. Install telephone/power service poles in accordance with final furnishing arrangement. Poles shall be plumb, true, and secure.

H. Provide GFCI type outlets as required in NEC 210, including but not limited to: each above counter duplex receptacle shown within 6 feet-0 inches of sinks/lavatories; Bathrooms; Kitchens; Roof Tops; Outdoors; Indoor Wet locations; Locker Rooms; Shower Facilities; Garages; Service Bays; vending machines; etc. For above counter multi-outlet assemblies
which do not contain duplex receptacles that can be replaced with GFCI devices, provide GFCI circuit breakers on the branch circuit(s) feeding the assembly. Where GFCI devices are required and/or shown but are not readily accessible when equipment is installed, i.e. vending machines, etc., provide blank face GFCI device and cover-plate ahead of inaccessible receptacles. Mount adjacent to equipment at switch height unless otherwise shown. Install individual GFCI devices at each location shown, feed through devices are only acceptable where specifically called for.

3.2 PROTECTION OF WALLPLATES AND RECEPTACLES:

A. Upon installation of wall-plates and receptacles, advise Contractor regarding proper and cautious use of convenience outlets. At time of Substantial Completion, replace those items which have been damaged, including those burned and scored by faulty plugs.

3.3 GROUNDING:

A. Provide equipment grounding connections for wiring devices, unless otherwise indicated. Tighten connections to comply with tightening torques specified in UL Std. 486A to assure permanent and effective grounds.

3.4 CLEANING:

A. Internally clean devices, device outlet boxes and enclosures. Replace stained, cracked, damaged or improperly painted wall plates or devices. Remove temporary markings of labels.

3.5 TESTING:

A. Prior to energizing circuitry, test wiring for electrical continuity, and for short-circuits. Ensure proper polarity of connections is maintained and prepare test reports. Subsequent to energization, test wiring devices to demonstrate compliance with requirements.

1. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices or similar problems.
2. Tests for Convenience Receptacles:
   a. Line Voltage: Acceptable range is 114 to 126 V.
   b. Ground Impedance: Values of up to 2 ohms are acceptable.
   c. Polarity: Test for correct neutral conduct to neutral terminal connection.
   d. Using the test plug, verify that the device and its outlet box are securely mounted.
   e. GFCI Receptacles: Test for tripping values specified in UL 1436 and UL 943. Test with both local and remote fault simulations in accordance with manufacturing recommendations.
   f. SPD receptacle indicating lights for normal indication check.
3. Test Instruments:
   a. Use instruments that comply with UL 1436.
   b. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.
B. Correct Deficiencies and Report:

1. Correct unsatisfactory conditions and retest to demonstrate compliance; replace devices as required to bring system into compliance.
2. Correct malfunctioning units on-site, where possible and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Prepare a report that identifies enclosure, units, conductors and devices checked and describe results. Include notation of deficiencies detected, remedial action taken, and observations and test results after remedial action.

END OF SECTION 262726
SECTION 262800 - LOW-VOLTAGE CIRCUIT PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 SUMMARY:

A. This section includes overcurrent protective devices (OCPD’s) rated 600 V and below and switching devices commonly used with them.

B. Panelboards: Application, installation, and other related requirements for overcurrent protective device installations in distribution equipment are specified in other Division 26 sections.

1.2 DEFINITIONS:

A. Overcurrent Protective Device (OCPD): A device operative on excessive current that causes and maintains the interruption of power in the circuit it protects.

B. Ampere-Squared-Seconds: An expression of available thermal energy resulting from current flow. With regard to current-limiting fuses and circuit breakers, the ampere-squared-seconds during fault current interruption represents the energy allowed to flow before the fuse or breaker interrupts the fault current within its current limiting range.

1.3 SUBMITTALS:

A. See Section 26 05 00 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.

B. Product data for fuses, fusible switches, circuit breakers, and OCPD accessories specified in this Section, including descriptive data and time-current curves for all protective devices and let-through current curves for those with current limiting characteristics. Include coordination charts and tables and related data.

1.4 QUALITY ASSURANCE:

A. Manufacturers: Firms regularly engaged in manufacture of overcurrent protective devices of types, sizes, and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Each type of OCPD shall be the product of a single manufacturer.

1.5 EXTRA MATERIALS:

A. Spare Fuses: Furnish spares of each type and rating of fuse for fusible devices amounting to one set of 3 fuses for each 9 fuses installed but not less than 3 fuses of each type.
PART 2 - PRODUCTS:

2.1 MANUFACTURERS:

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Cartridge Fuses:
   a. Bussmann Div., Cooper Industries, Inc.
   b. Littelfuse Inc.

2. Fusible Switches:
   a. General Electric Co.
   b. Square D Co.
   c. Allen-Bradley Co.
   d. Siemens Energy & Automation, Inc.
   e. Eaton

3. Molded-Case Circuit Breakers:
   a. Square D Co.
   b. General Electric Co.
   c. Siemens Energy & Automation, Inc.
   d. Eaton

4. Combination Circuit Breaker and Ground Fault Circuit Interrupters:
   a. General Electric Co.
   b. Square D Co.
   c. Siemens Energy & Automation, Inc.
   d. Eaton

5. When mounting overcurrent protective devices in switchboards, switchgear, panelboards, MCC's, etc., provide equipment of same manufacturer as equipment into which they are being mounted.

2.2 OVERCURRENT PROTECTIVE DEVICES (OCPDS), GENERAL:

A. General: Provide OCPDs in indicated types, as integral components of panelboards, switchboards, motor control centers, and other related equipment; and also as individually enclosed and mounted single units.

B. Enclosures: NEMA 250 "Enclosures for Electrical Equipment (1,000 Volts Maximum)." 

C. Where OCPD's are to be installed in existing panelboards, switchboards, and motor control centers, they shall be of the same manufacture and type as those existing in the equipment. If this is not possible, provide devices which are compatible with the existing equipment and when installed will not void the U.L. label or reduce the short circuit rating of the equipment.

D. All overcurrent devices shall be individually rated for the available fault current unless otherwise noted. Series ratings of equipment will only be allowed where specifically called out.
E. Ground Fault Protection: Distribution circuit breakers: provide integral, self-powered type with mechanical ground fault indicator, test function, adjustable pick-up current and delay time with inverse and constant time characteristics, internal memory arranged to integrate intermittent arcing ground faults, and ground fault current sensor located as indicated or required. Provide combination devices for branch circuit protection as follows; where shown or required provide 30 mA Ground Fault circuit breakers for each circuit feeding Electrical Heat Trace to protect from overheating and fire and 5 mA Ground Fault circuit breakers for each circuit feeding receptacles to protect personnel. Coordinate with manufacturer’s instructions.

2.3 CARTRIDGE FUSES:

A. General: NEMA Standard FU1, "Low-Voltage Cartridge Fuses." Unless indicated otherwise, provide nonrenewable cartridge fuses of indicated types, classes, and current ratings that have voltage ratings consistent with the circuits on which used.

B. All fuses used for main, feeder, or branch-circuit protection shall be Underwriters Laboratories listed, current-limiting fuses with 200,000 ampere interrupting rating and shall be so labeled. Fuses used for supplementary protection (other than branch circuit protection) shall be as specified above or shall be U.L. approved or component recognized for such purposes. All fuses provided shall be furnished by the same manufacturer. Should equipment provided require a different U.L. Class or size of fuse, the engineer shall be furnished sufficient data to ascertain that system function will not be adversely affected.

C. In order to simplify fuse replacement, reduce spare fuse inventory and insure adequate thermal protection, all fuses 600 amperes and below shall be true dual-element time-delay fuses with separate spring-loaded thermal overload elements in all ampere ratings. All ampere ratings shall be designed to open at 400 degrees F or less when subjected to a non-load oven test.

D. To eliminate induction heating, all fuse ferrules and end caps shall be non-ferrous and shall be bronze or other alloy not subject to stress cracking.

E. Class L Fuses: UL 198C, "High-Interrupting Capacity Fuses, Current-Limiting Type."

F. Class RK1 Dual Element Time-Delay Fuses: UL 198E, "Class R Fuses."

G. Class J Low-Peak dual Element Fuse: UL 198C

2.4 NONFUSIBLE SWITCHES:

A. General: UL 98 "Enclosed and Dead Front Switches" and NEMA KS 1 "Enclosed Switches," quick-make, quick-break heavy-duty units.

B. Rating: Load-breaking capacity in excess of the normal horsepower rating for the switch.

C. Withstand Capability: In excess of the available.

D. Operation: By means of external handle.

E. Interlock: Prevents access to switch interior except when in "off" position.
F. Enclosure for Independent Mounting: NEMA Type 1 enclosure except as otherwise indicated or required to suit environment where located.

G. Contacts shall be NEMA rated 75 degrees C.

H. Provide auxiliary contacts for disconnects supplied from variable frequency drives.

2.5 FUSIBLE SWITCHES:

A. General: UL 98 "Enclosed and Dead Front Switches" and NEMA KS 1 "Enclosed Switches," quick-make, quick-break heavy-duty units.

B. Rating: Load-breaking capacity in excess of the normal horsepower rating for the switch.

C. Withstand Capability: In excess of the let-through current permitted by its fuse when subject to faults up to 100,000 RMS symmetrical amperes.

D. Operation: By means of external handle.

E. Interlock: Prevents access to switch interior except when in "off" position.

F. Fuse Clips: Rejection type.

G. Enclosure for Switchboard or Panel board Mounting: Suitable for panel mounting where indicated.

H. Enclosure for Independent Mounting: Provide NEMA Type 1 enclosure except as otherwise indicated or required to suit environment where located.

I. Contacts shall be NEMA rated 75 degrees C.

J. Provide fuses for safety switches and other equipment of classes, types, and rating needed to fulfill electrical requirements for services indicated.

K. Provide auxiliary contacts for disconnects supplied from variable frequency drives.

2.6 MOLDED-CASE CIRCUIT BREAKERS:

A. General: UL 489, "Molded Case Circuit Breakers and Circuit Breaker Enclosures," and NEMA AB 1, "Molded Case Circuit Breakers."

B. Construction: Provide bolt-in type, except breakers 225-ampere frame size and larger which may be plug-in type if held in place by positive locking device requiring mechanical release for removal.

C. Characteristics: Indicated frame size, trip rating, number of poles, and a short-circuit interrupting capacity rating as indicated or required to match existing devices or equipment.

D. Tripping Device: Quick-make, quick-break toggle mechanism with inverse-time delay and instantaneous overcurrent trip protection for each pole. Trip unit to be interchangeable within frame sizes for breakers 200 amperes or larger. Breakers 150 amperes and above shall have
adjustable trip selection for trip units. All 120/208 volt rated breakers shall be rated and labeled "High Magnetic".

E. Adjustable Instantaneous Trip Devices: Factory adjusted to low-trip-setting current values. Provide adjustable instantaneous trip devices for each circuit breaker supplying individual motor loads and where indicated.

F. Enclosure for Switchboard or Panelboard Mounting: Suitable for panel mounting in switchboard or panelboards where indicated.

G. Enclosure for Switchboard or Motor Control Center Mounting: Provide individual mounting where indicated.

H. Enclosure for Independent Mounting: NEMA Type 1 enclosure, except as otherwise indicated or required to suit environment where located.

2.7 COMBINATION CIRCUIT BREAKERS AND GROUND FAULT CIRCUIT INTERRUPTERS:

A. General: UL 943 "Ground Fault Circuit Interrupters," arranged for sensing and tripping for ground fault current in addition to overcurrent and short-circuit current. Provide features as follows:

1. Match features and module size of panelboard breakers and provide clear identification of ground fault trip function.

2.8 OCPD ACCESSORIES:

A. Provide shunt-trip devices for Circuit breakers where required or indicated. Arrange to trip breaker from an external source of power through a control switch or relay contact.

B. Lock-Out Devices: Provide padlocking provisions on each overcurrent protective device, lockable in the open or closed position. Provide 3 sets of lockout/tagout devices for each type of breaker or switch provided. Include tags, locks and all accessories necessary.

PART 3 - EXECUTION:

3.1 INSTALLATION:

A. Independently Mounted OCPDs: Locate as indicated and install in accordance with manufacturer's written installation instructions. Install OCPDs level and plumb.

B. OCPDs in new distribution and branch circuit equipment shall be factory installed. OCPD's in existing distribution and branch circuit equipment shall match existing for type and be provided with features as listed herein.

C. Install fuses in fusible devices as indicated. Arrange fuses so that fuse ratings are readable without removing fuse.

D. All fuses for new disconnect switches or MCC’s feeding motors or motor starters shall be provided with Class J fuses.
E. OCPDs and mounting accessories installed in existing equipment shall match the existing manufacturer and be rated for the available fault current.

3.2 IDENTIFICATION:
A. Identify components in accordance with Division 26 Section on electrical identification.

3.3 CONTROL WIRING INSTALLATION:
A. Install wiring between OCPDs and control/indication devices.

3.4 CONNECTIONS:
A. Check connectors, terminals, bus joints, and mountings for tightness. Tighten field-connected connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values. Where manufacturer's torqueing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A and UL 486B.

3.5 GROUNDING:
A. Provide equipment grounding connections for individually mounted OCPD units as indicated and as required by NEC. Tighten connectors to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounding.

3.6 FIELD QUALITY CONTROL:
A. Reports: Prepare written reports on tests and observations. Report defective materials and workmanship and unsatisfactory test results. Include complete records of repairs and adjustments made. Tests shall be made on all new and existing OCPD's provided and/or connected under this project in accordance with this section.

B. Labeling: Upon satisfactory completion of tests and related effort, apply a label to tested components indicating test results, date, and responsible organization and person.

C. Schedule visual and mechanical inspections and electrical tests with at least one week's advance notification.

D. Upon completing installation of the system, perform the following tests on all new equipment and existing equipment as indicated on the drawings:

1. Visual and mechanical inspection: Include the following inspections and related work.
   a. Overcurrent-Protective-Device Ratings and Settings: Verify indicated ratings and settings to be appropriate for final system arrangement and parameters.
   b. Inspect for defects and physical damage, NRTL labeling, and nameplate compliance with current single line diagram.
   c. Exercise and perform operational tests of all mechanical components and other operable devices in accordance with manufacturer's instruction manual.
   d. Check tightness of electrical connections of OCPD’s with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.
e. Clean OCPD’s using manufacturer's approved methods and materials.
f. Verify installation of proper fuse types and ratings in fusible OCPD’s.

2. Electrical Tests: Perform the following tests in accordance with manufacturer's instructions:

a. Insulation resistance test of fused power circuit devices, insulated-case, and molded-case circuit breakers, 600-ampere frame size and over at 1000 degree V D.C. for one minute from pole to pole and from each pole to ground with breaker closed and across open contacts of each phase. Insulation resistance less than 100 megohms is not acceptable.
b. Make insulation resistance tests of OCPD buses, components, and connecting supply, feeder, and control circuits.
c. Make continuity tests of circuits.
d. Provide full rated primary current tests conforming to IETA testing standards of all new and existing breakers 800 amperes and greater, connected under this project. Inspect breakers and provide test report. Set breakers to previous or new settings as directed prior to test.
e. Verify relay operation by introduction of accurately metered currents into overcurrent/ground fault/ and other circuitry at values which will enable accurate determination of the tripping or activation values.

E. Make adjustments for final settings of adjustable-trip devices.

F. Activate auxiliary protective devices such as ground fault or under-voltage relays, to verify operation of shunt-trip devices.

G. Check key and other interlock and safety devices for operation and sequence. Make closing attempts on locked-open and opening attempts on locked-closed devices including moveable barriers and shutters.

H. Retest: Correct deficiencies identified by tests and observations and provide retesting of OCPDs by testing organization. Verify by the system tests that specified requirements are met.

3.7 CLEANING:

A. Upon completion of installation, inspect OCPD’s. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

3.8 DEMONSTRATION:

A. Training: Arrange and pay for the services of factory-authorized service representatives to demonstrate OCPD’s and train Owner's maintenance personnel. //OR Demonstrate OCPD’s and train Owner's maintenance personnel.

B. Conduct a minimum of one half day of training in operation and maintenance as specified under in the Project Closeout Section of these specifications. Include both classroom training and hands-on equipment operation and maintenance procedures.

C. Schedule training with at least seven days' advance notification.
END OF SECTION 262800