



## **UNIVERSITY OF COLORADO DENVER**

**ARTS Ft. Logan Reno Bldg 16**

**PN 22-106819**

**STATE OF COLORADO  
STATE BUILDINGS AND REAL ESTATE PROGRAMS**

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**100% CD For Construction Documents Specifications  
April 12, 2022**

Architect: Architectural Workshop, LLC.  
2 Kalamath Street  
Denver, CO 80223  
Ph: 303.788.1717

Digitally signed  
by Joseph S  
Marshall  
Contact Info:  
303.788.1717  
Date:  
2022.04.28  
09:32:30-06'00'

A circular digital signature stamp for Joseph Steven Marshall, a Licensed Architect in the State of Colorado. The stamp includes his name, license number 404854, and the text 'STATE OF COLORADO' and 'LICENSED ARCHITECT'.



**ADVERTISEMENT FOR BID  
Design/Bid/Build  
State of Colorado**

**University of Colorado Anschutz medical Campus  
Notice Number: 22-106819**

**Notice Status: OPEN**  
**Publish Date: 11/18/2022**  
**Revisions: 0**  
**Revision Publish: N/A**

**Project #: 22-106819**  
**Project Title: ARTS Ft. Logan Reno Kitchen Bldg 16**  
**Estimated Construction Cost: \$136,850.00**

**Settlement Notice**

**For all projects with a total dollar value above \$150,000 Notice of Final Settlement is required by C.R.S. §38-26-107(1).**

**Final Settlement, if required, will be advertised via: electronic media**

**Project Description**

The intent of the project is to renovate a kitchen in a building (3854 W Princeton Circle), located in Southwest Denver on the Ft. Logan grounds. Ft. Logan was originally created as an Army base in the 1800s and the kitchen remodel project is located in a structure which was intended to house military officers and their families. Once the base closed in 1945, the buildings were transferred over to Colorado Department of Human Services and then leased out to a multitude of organizations.

The University of Colorado, School of Medicine, Addiction Research and Treatment Services - ARTS, began utilizing multiple buildings on the Ft Logan grounds approximately 40 years ago. ARTS provides lifesaving, evidence-based substance use and mental health services for men and women.

3854 W Princeton Circle, also known as Reflections for Women offers a comprehensive set of family-centered interventions designed to keep women in treatment and ensure their families thrive. The client population is adult women, including pregnant and parenting women and their children who reside with them during their treatment. Clients also exhibit other problems correlated with substance use disorders, such as histories of trauma and abuse, homelessness, inadequate education and work skills. ARTS mission is to improve the quality of life and productivity of individuals and families affected by substance use and co-occurring mental health disorders through the application of scientifically supported prevention, education, and treatment services.

ARTS has received a capital grant to renovate a commercial kitchen and dining area for clients and their children. Reflections for women will provide cooking and nutrition class to all clients in the fully renovated kitchen. Healthy cooking and the opportunity to eat together as a family is a strong component in creating a productive lifestyle and long-term recovery. The new kitchen is another treatment tool to provide a two generational positive outcome for clients and their children.

### **Scope of Services**

The University of Colorado, School of Medicine has been working with an architect and engineering team to create the scope of work and 100% complete CD drawings and specs. The project includes renovating the kitchen in 3854 W Princeton Cir. Work to be done will include, demo and disposal of existing floor, kitchen equipment, doors and cabinetry. It will also include installation of new flooring and cove base, new cabinetry and millwork, quartz countertops, doors, patch and paint walls, HVAC, electrical and plumbing upgrades.

### **Minimum Requirements**

Notice is hereby given to all interested parties that all firms will be required to meet all minimum requirements to be considered for this project. To be considered as qualified, interested firms shall have, as a minimum:

1. Contractor must currently be listed on the University SCPP Pre-Qualified Contractors List at:

<https://www.cuanschutz.edu/offices/facilities-management/construction-projects/small-construction-purchase-program>

2. Contractor to adhere to University and department scheduling and coordination requirements for shutdown and noise related work.

3. Contractor to execute a procurement phase completing submittal process to ensure materials are delivered to project prior or during construction phase.

4. Bid Bond is required if project exceeds \$50,000; and

**Firms meeting the minimum requirements may obtain the bidding documents on the website accompanying this advertisement.**

University of Colorado Denver | Anschutz Medical Campus Facilities Projects- **Request for Proposals** website: <https://www.cuanschutz.edu/offices/facilities-management/construction-projects/RFP>

Colorado CORE/ColoradoVSS:

<https://codpavss.cloud.cgifederal.com/webapp/PRDVSS2x1/AltSelfService>

## **Bid Documents**

Project Bid Documents are available on the Facilities website:

<https://www.cuanschutz.edu/offices/facilities-management/construction-projects/RFP>

## **Other Information**

Preference shall be given to Colorado resident bidders and for Colorado labor, as provided by law.

## **Pre-Bid Meeting (Mandatory)**

**A mandatory Pre-Bid Meeting will be held at:**

**Address:** 3854 W Princeton Circle, Denver CO 80202

**Room:** Front exterior of the building, East Side

**Date/Time** 12/02/2022 @ 2:00 pm

**Comments: All participants will be asked to submit their questions via email.**

## **Schedule/Submission Details**

1. The schedule of events for the AFB process and an outline of the schedule for the balance of the project is as follows:

Advertisement	11/18/2022
Mandatory Pre-Bid Conference and Tour	12/02/2022 2:00pm
Date Email Questions Due	12/09/2022 2:00pm
Date Email Answers Issued	12/14/2022 2:00pm
Documented Quotes Due	12/21/2022 2:00pm
Bid Results Published (Facilities Project Website)	12/23/2022
Negotiation of General Contractor Contract	12/23/2022
Contract Approval (projected)	01/13/2023
Anticipated Design Start	Complete
Anticipated Procurement Phase Start	01/13/2023
Anticipated Construction Start	01/30/2023
Anticipated Construction Finish	04/28/2023

2. All Documented Bids submissions shall be ONE (1) electronic copy PDF received no later than 12/21/2022 @ 2:00pm, and shall be submitted via email to:

[https://ucdenverdata.formstack.com/forms/rfp\\_rfq\\_submission](https://ucdenverdata.formstack.com/forms/rfp_rfq_submission)

**Comments:** Late submissions will be rejected without consideration. The University of Colorado Anschutz Medical Campus (GFE) and the State of Colorado assume no responsibility for costs related to the preparation of submittals.

3. The above schedule is tentative. Responding firms shall be notified of revisions in a timely manner by email. Respondents may elect to verify times and dates by email, but no earlier than 36 hours before the scheduled date and time.

**Point of Contact/Clarification**

Name: **Stephanie Menke**  
Agency: University of Colorado Anschutz Medical Campus (GFE)  
Phone: 303.483.1594  
Email: [stephanie.menke@cuanschutz.edu](mailto:stephanie.menke@cuanschutz.edu)

**This Notice is also available on the web at:**

[www.colorado.gov/pacific/osa/cdnotices](http://www.colorado.gov/pacific/osa/cdnotices)

Media of Publication(s): University of Colorado Anschutz Medical Campus Facilities  
Projects Website

Colorado CORE/ColoradoVSS

Publication Dates: **11/18/2022**

Appendices:

Appendix A: Information for Bidders (SBP-6.12)

Appendix B: Bid Form (SBP-6.13)

Appendix B2 Bid Bond (SBP-6.14)



STATE OF COLORADO  
OFFICE OF THE STATE ARCHITECT  
STATE BUILDINGS PROGRAMS

INFORMATION FOR BIDDERS

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Institution or Agency: University of Colorado Denver | Anschutz Medical Campus  
Project No./Name: PN22-106819 ARTS Ft. Logan Reno Bldg. 16

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1. **BID FORM:** Bidders are required to use the Bid form attached to the bidding documents. Each bidder is required to bid on all alternates and indicate the time from the date of the Notice to Proceed to Substantial Completion in calendar days, and in addition, the bidder is required to indicate the period of time to finally complete the project from Substantial Completion to Final Acceptance, also in calendar days. Bids indicating times for Substantial Completion and Final Acceptance in excess of the number of days indicated in the Advertisement for Bids for completion of the entire Project may be found non-responsive and may be rejected. The bid shall not be modified or conditioned in any manner. Bids shall be submitted in sealed envelopes bearing the address and information shown below. If a bid is submitted by mail, this aforementioned sealed envelope should be enclosed in an outer envelope and sent to the following addressee:

**INSERT NAME OF AGENCY AND ADDRESS WHERE BID SHOULD BE DELIVERED**

The outside of the sealed inner envelope should bear the following information:

**Project # - 22-106819**

**Project Name- ARTS Ft. Logan Reno Bldg. 16**

**Name and Address of Bidder**

**Date of Opening**

**Time of Opening**

2. **INCONSISTENCIES AND OMISSIONS:** Bidders may request clarification of any seeming inconsistencies, or matters seeming to require explanation, in the bidding documents at least three (3) business days prior to the time set for the opening of Bids. Decisions of major importance on such matters will be issued in the form of addendum.
3. **APPLICABLE LAWS AND REGULATIONS:** The bidder's attention is called to the fact that all work under this Contract shall comply with the provisions of all state and local laws, approved state building codes, ordinances and regulations which might in any manner affect the work to be done or those to be employed in or about the work. Attention is also called to the fact that the use of labor for work shall be governed by the provisions of Colorado law which are hereinafter set forth in Articles 27 and 52E of the GENERAL CONDITIONS. This includes the requirements for apprenticeship and prevailing wage on Public Projects.
4. **BID SECURITY:** A bid security of not less than 5% of the bid price is required when the price is estimated to be \$50,000 or more. The security shall be a bond by a surety company, the equivalent in cash, or otherwise supplied in a form satisfactory for the State. Noncompliance requires the bid to be rejected as nonresponsive.
- 5.
6. **TAXES:** The bidder's attention is called to the fact that the Bid submitted shall exclude all applicable federal excise or manufacturers' taxes and all state sales and use taxes as hereinafter set forth in Article 9C of the GENERAL CONDITIONS.
7. **OR EQUAL:** The words "OR EQUAL" are applicable to all specifications and drawings relating to materials or equipment specified. Any material or equipment that will fully perform the duties specified, will be considered "equal", provided the bid submits proof that such material or equipment is of equivalent substance and function and is approved, in writing. Requests for the approval of "or equal" shall be made in writing at least five (5) business days prior to bid opening. During the bidding period, all approvals shall be issued by the Architect/Engineer in the form of addenda at least two (2) business days prior to the bid opening date.

8. **ADDENDA:** Owner/architect initiated addenda shall not be issued later than two (2) business days prior to bid opening date. All addenda shall become part of the Contract Documents and receipt must be acknowledged on the Bid form.
9. **METHOD OF AWARD - LOWEST RESPONSIBLE BIDDER:** If the bidding documents for this project require alternate prices, additive and/or deductible alternates shall be listed on the alternates bid form provided by the Principal Representative. Bidders should note the Method of Award is applicable to this Bid as stated below.
  - A. **DEDUCTIBLE ALTERNATES:** The lowest responsible Bid, taking into account the Colorado resident bidder preference provision of Colorado law, will be determined by and the contract will be awarded on the base bid combined with deductible alternates, deducted in numerical order in which they are listed in the alternates bid form provided by the Principal Representative. The subtraction of alternates shall result in a sum total within available funds. If this bid exceeds such amount, the right is reserved to reject all bids. An equal number of alternates shall be subtracted from the base bid of each bidder within funds available for purposes of determining the lowest responsible bidder.
  - B. **ADDITIVE ALTERNATES:** The lowest responsible Bid, taking into account the Colorado resident bidder preference provision of Colorado law, will be determined by and the contract will be awarded on the base bid plus all additive alternates added in the numerical order in which they are listed in the alternates bid form provided by the Principal Representative. The addition of alternates shall result in a sum total within available funds. If this bid exceeds such amount, the right is reserved to reject all bids. An equal number of alternates shall be added to the base bid of each bidder within funds available for purposes of determining the lowest responsible bidder.
  - C. **DEDUCTIBLE AND ADDITIVE ALTERNATES:** Additive alternates will not be used if deductible alternates are used and deductible alternates will not be used if additive alternates are used.
10. **NOTICE OF CONTRACTOR'S SETTLEMENT** – Agencies/institutions must indicate in the initial Solicitation (Advertisement for Bids, Documented Quotes, or Requests for Proposals) whether settlement will be advertised in newspapers or electronic media.



STATE OF COLORADO  
OFFICE OF THE STATE ARCHITECT  
STATE BUILDINGS PROGRAMS

**BID**

Institution/Agency: University of Colorado Denver | Anschutz Medical Campus

Project No./Name: PN22-106819 ARTS Ft. Logan Reno Bldg. 16

Bidder Acknowledges Receipt of Addenda Numbers:

Bidder Anticipates Services outside the United States or Colorado:\*

Bidder will comply with 80% Colorado Labor on project above \$500,000:

Bidder is a Service-Disabled Veteran Owned Small Business:\*

No <input checked="" type="checkbox"/>	Yes <input type="checkbox"/> If Yes see 3A below
Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/> If No see 3B below
No <input type="checkbox"/>	Yes <input type="checkbox"/> If Yes see 3C below

**Base Bid**

\$

(Refer to Bid Alternate Form SC-6.13.1 Attached, If Applicable)

Bidder's Time of Completion

a. Time Period from Notice to Proceed to Substantial Completion:

90 Days

b. Time Period from Substantial Completion to Final Acceptance:

10 Days

c. Total Time of Completion of Entire Project (a + b):

100 Days

- BID:** Pursuant to the advertisement by the State of Colorado dated 11/18/2022 the undersigned bidder hereby proposes to furnish all the labor and materials and to perform all the work required for the complete and prompt execution of everything described or shown in or reasonably implied from the Bidding Documents, including the Drawings and Specifications, for the work and for the base bid indicated above. Bidders should include all taxes that are applicable.
- EXAMINATION OF DOCUMENTS AND SITE:** The bidder has carefully examined the Bidding Documents, including the Drawings and Specifications, and has examined the site of the Work, so as to make certain of the conditions at the site and to gain a clear understanding of the work to be done.
- PARTIES INTERESTED IN BID:** The bidder hereby certifies that the only persons or parties interested in this Bid are those named herein, and that no other bidder or prospective bidder has given any information concerning this Bid.
  - If the bidder anticipates services under the contract or any subcontracts will be performed outside the United States or Colorado, the bidder shall provide in a written statement which must include, but need not be limited to the type of services that will be performed at a location outside the United States or Colorado and the reason why it is necessary or advantageous to go outside the United States or Colorado to perform such services. (Does not apply to any project that receives federal moneys) \*
  - For State Public Works projects per C.R.S. 8-17-101, Colorado labor shall be employed to perform at least 80% of the work. Colorado Labor means any person who is a resident of the state of Colorado at the time of the Public Works project. Bidders indicating that their bid proposal will not comply with the 80% Colorado Labor requirement are required to submit written justification along with the bid submission. (Does not apply to any project that receives federal moneys) \*
  - A Service-Disabled Veteran Owned Small Business (SDVOSB) per C.R.S. 24-103-211, means a business that is incorporated or organized in Colorado or maintains a place of business or has an office in Colorado and is officially registered and verified by the Center for Veteran Enterprise within the U.S. Department of Veteran Affairs. Attach proof of certification along with the bid submission. \*
  - Projects estimated to be \$1 million or more that do not receive federal funds are required to comply with the State Apprenticeship Utilization requirements C.R.S. 24-92-115
  - Projects estimated to be \$500,000 or more that do not receive federal funds are required to comply with the State Prevailing Wage requirements C.R.S. 24-92-201 through 210.
- BID GUARANTEE:** This Bid is accompanied by the required Bid Guarantee. Per C.R.S. §24-105-201 If the construction value is \$50,000 or greater a Bid Bond and Power of Attorney or Proposal Guaranty is required in an amount not less than 5% of the total Bid. You are authorized to hold said Bid Guarantee for a period of not more than thirty (30) days after the opening of the Bids for the work above indicated, unless the undersigned bidder is awarded the Contract, within said period, in which event the Office of the State Architect, may retain said Bid Guarantee, until the undersigned bidder



has executed the required Agreement and furnished the required Performance Bond, Labor and Material Payment Bond, and Insurance Policy.

5. **TIME OF COMPLETION:** The bidder agrees to achieve Substantial Completion of the Project from the date of the Notice to Proceed within the number of calendar days entered above, and in addition, further agrees that the period between Substantial Completion and Final Acceptance of the Project will not exceed the number of calendar days noted above. If awarded the Work, the bidder agrees to begin performance within ten (10) days from the date of the Notice to Proceed subject to Article 46, Time of Completion and Liquidated Damages of the General Conditions of the Contract, and agrees to prosecute the Work with due diligence to completion. The bidder represents that Article 7D of the Contractor's Agreement (SC-6.21) has been reviewed to determine the type and amount of any liquidated damages that may be specified for this contract.
6. **EXECUTION OF DOCUMENTS:** The bidder understands that if this Bid is accepted, bidder must execute the required Agreement and furnish the required Performance Bond, Labor and Material Payment Bond, Insurance Policy and Certificates of Insurance within ten (10) days from the date of the Notice of Award, and that the bidder will be required to sign to acknowledge and accept the Contract Documents, including the Drawings and Specifications.
7. **ALTERNATES:** Refer to the Information for Bidders (SC-6.12) for Method of Award for Alternates and use State Form SBP-6.13.1 Bid Alternates form to be submitted with this bid form if alternates are requested by the institution/agency in the solicitation documents.
8. **Submit wage rates** (direct labor costs) for prime contractor and subcontractor as requested by the institution/agency in the solicitation documents.
9. **The right is reserved to waive informalities and to reject any and all Bids.**

*\*Does not apply to projects for Institutions of Higher Education that have opted out of the State Procurement Code.*

**SIGNATURES:** If the Bid is being submitted by a Corporation, the Bid shall be signed by an officer, i.e., President or Vice-President. If a sole proprietorship or a partnership is submitting the Bid, the Bid shall so indicate and be properly signed.

Dated this \_\_\_\_\_ Day of \_\_\_\_\_, 20\_\_\_\_

THE BIDDER:

\_\_\_\_\_  
Company Name

\_\_\_\_\_  
Address (including city, state and zip)

\_\_\_\_\_  
Phone number:

\_\_\_\_\_  
Name (Print) and Title

\_\_\_\_\_  
Signature



STATE OF COLORADO  
OFFICE OF THE STATE ARCHITECT  
STATE BUILDINGS PROGRAM

**COLORADO BID BOND**

Institution/Agency: University of Colorado Denver | Anschutz Medical Campus

Project No./Name: PN22-106819 ARTS Ft. Logan Reno Bldg. 16

**KNOW ALL MEN BY THESE PRESENTS:**

**WHEREAS**, \_\_\_\_\_ hereinafter called the "PRINCIPAL", is submitting a PROPOSAL for the above described project, to the STATE OF COLORADO, hereinafter called the "OBLIGEE".

**WHEREAS**, the Advertisement for Bids has required as a condition of receiving the Proposals that the Principal submit with the PROPOSAL GUARANTY in an amount not less than five per cent (5%) of the Proposal, which sum it is specifically agreed is to be forfeited as Liquidated Damages in the event that the Principal defaults in his obligation as hereinafter specified, and, in pursuance of which Requirement, this Bid is made, executed and delivered.

**NOW THEREFORE**, the Principal and \_\_\_\_\_ a corporation of the State of \_\_\_\_\_, duly authorized to transact business in Colorado, as Surety, are held and firmly bound unto the Obligee, in the sum of five per cent (5%) of the Principal's total bid price, lawful money of the United States for the payment of which sum, well and truly to be made to the Obligee, we bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

**FURTHER THAT**, a condition of the obligation that the Principal shall maintain his Proposal in full force and effect for thirty (30) days after the opening of the proposals for the project, or, if the Principal's Proposal is accepted, the Principal shall, within the prescribed time, execute the required Agreement, furnish the required Performance Bond, Labor and Material Payment Bond, Insurance Policy, and Certificates of Insurance, then this obligation shall be null and void, otherwise it shall remain in full force and effect, and subject to forfeiture upon demand as Liquidated Damages.

**IN WITNESS WHEREOF** said Principal and Surety have executed this Bond, this \_\_\_\_\_ day of \_\_\_\_\_, A.D., 20\_\_.

(Corporate Seal)

**THE PRINCIPAL**

ATTEST

\_\_\_\_\_  
Company Name

\_\_\_\_\_  
Secretary

\_\_\_\_\_  
Address (including city, state and zip)  
Phone  
number: \_\_\_\_\_

\_\_\_\_\_  
Name (Print)

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Name (Print) and Title

**SIGNATURES** If the "Principal" is doing business as a Corporation, the Bid Bond shall be signed by an officer, i.e., President or Vice President. The signature of the officer shall be attested to by the Secretary and properly sealed.

If the "Principal" is an individual or a partnership, the Bid Bond shall so indicate and be properly signed.

(Corporate Seal)

**THE SURETY**

\_\_\_\_\_  
By \_\_\_\_\_

\_\_\_\_\_  
Secretary

\_\_\_\_\_  
Attorney-in-Fact

**THIS BOND MUST BE ACCOMPANIED BY POWER OF ATTORNEY, EFFECTIVELY DATED.  
FAILURE TO PROVIDE A PROPERLY EXECUTED BID BOND WITH A PROPERLY EXECUTED POWER OF ATTORNEY  
WILL RESULT IN THE BIDDER'S PROPOSAL BEING DEEMED NON-RESPONSIVE.**

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**END OF SECTION 00 01 00**

## SECTION 01 10 00 - SUMMARY

### 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.
- 6. University-furnished, Contractor-installed products.
- 7. Access to site.
- 8. Coordination with occupants.
- 9. Work restrictions.
- 10. Specification and drawing conventions.

- B. Related Requirements:

- C. Section 01 35 46 "Indoor Air Quality Procedures" for requirements and procedures related to maintaining air quality in adjacent occupied spaces and buildings.
  - 1. 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: Arts Ft. Logan Reno Building 16

- 1. Project Location: 3844 & 3854 W. Princeton Cir, Denver, CO 80202

- B. Principal Representation: University of Colorado Anschutz

- 1. University's Representative: Andy Madsen Ph: 303-880-7569

- C. Architect/Engineer: Architectural Workshop – Joe Marshall Ph: 303-788-1717.

- D. Architect/Engineer's Consultants: The Architect/Engineer has retained the following design professionals who have prepared designated portions of the Contract Documents:

- 1. BG Buildingworks – Mike Reed Ph: 303-278-3820.

#### 1.4 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. Tenant finish of Building 16's kitchen. The work includes the addition of a gas range and Ansul hood exhaust system. Work also includes replacement of the kitchen sink and finish upgrades throughout the kitchen. The existing back porch, off the kitchen, will be enclosed and converted to a storage area.

#### 1.5 WORK BY UNIVERSITY

- A. General: Cooperate fully with University or State of Colorado 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 or State of Colorado.

#### 1.6 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.

#### 1.7 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.
  - 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.
  - 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 the Universities Project Manager at least 5 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 the State of Colorado for any disruption to or temporary closures of public city streets.
- D. Construction Parking:
1. 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. 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.
    - b. 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.
  2. Parking on University/State 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.

## 1.8 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.

## 1.9 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 occupants 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. 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. 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.
- F. 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.
- G. 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.
- H. Nonsmoking Campus: Smoking, chewing tobacco, and other related tobacco product use is not permitted at any location on campus or on any adjacent property.
- I. 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.
- J. Designated Eating Areas: Restrict consumption of food on project site to designated eating areas as approved by University Project Manager.

#### 1.10 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.PRODUCTS (Not Used)

#### PART 2 - EXECUTION (Not Used)

**END OF SECTION 01 10 00**

## **SECTION 01 25 00 - SUBSTITUTION 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 substitutions.
- B. Related Requirements:
  - 1. Section 01 60 00 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

#### **1.3 DEFINITIONS**

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
  - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
  - 2. Substitutions for Convenience: Changes proposed by Contractor or College that are not required in order to meet other Project requirements but may offer advantage to Contractor or College.

#### **1.4 ACTION SUBMITTALS**

- A. Substitution Requests: Submit each request for consideration in format and quantities specified in Section 01 33 00 "Submittal Procedures". Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
  - 1. Substitution Request Form: Use CSI Form 13.1A or Contractor-generated form with substantially the same information.
  - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
    - a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
    - b. Coordination information, including a list of changes or revisions needed to other parts of the Work and to construction performed by College and separate contractors that will be necessary to accommodate proposed substitution.
    - c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect,

- sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
  - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
  - e. Samples, where applicable or requested.
  - f. Certificates and qualification data, where applicable or requested.
  - g. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
  - h. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
  - i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
  - j. Detailed comparison of Contractor's construction schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
  - k. Cost information, including a proposal of change, if any, in the Contract Sum.
  - l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
  - m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
3. Architect/Engineer's Action: If necessary, Architect/Engineer in consultation with the College will request additional information or documentation for evaluation within seven calendar days of receipt of a request for substitution. Architect/Engineer in consultation with the College will notify Contractor of acceptance or rejection of proposed substitution within 14 calendar days of receipt of request, or seven calendar days of receipt of additional information or documentation, whichever is later.
- a. Forms of Acceptance: Change Order.
  - b. Use product specified if Architect/Engineer does not issue a decision on use of a proposed substitution within time allocated.

#### 1.5 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

#### 1.6 PROCEDURES

- A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

## PART 2 - PRODUCTS

### 2.1 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 14 calendar days prior to time required for preparation and review of related submittals.
1. Conditions: Architect/Engineer in consultation with the College will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect/Engineer will return requests without action, except to record noncompliance with these requirements:
- a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
  - b. Requested substitution provides sustainable design characteristics that specified product provided.
  - c. Substitution request is fully documented and properly submitted.
  - d. Requested substitution will not adversely affect Contractor's construction schedule.
  - e. Requested substitution has received necessary approvals of authorities having jurisdiction.
  - f. Requested substitution is compatible with other portions of the Work.
  - g. Requested substitution has been coordinated with other portions of the Work.
  - h. Requested substitution provides specified warranty.
  - i. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
- B. Substitutions for Convenience: Not allowed.

## PART 3 - EXECUTION (Not Used)

**END OF SECTION 01 25 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. **[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]** 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.

1. Change Order Bulletin Form: State Form SC-6.311 available on the website of the Office of the State Architect.
  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.
1. Change Order Bulletin Form: State Form SC-6.311 available from the website of the Office of the State Architect.
  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.
1. Change Order Proposal Form: State Form SC-6.312 available from the website of the Office of the State Architect.
  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 the schedule of values in tabular form with separate columns to indicate the following for each item listed:
    - a. Related Specification Section or Division.
    - b. Description of the Work.
    - c. Name of subcontractor.
    - d. Name of manufacturer or fabricator.
    - e. Name of supplier.
    - f. Change Orders (numbers) that affect value.
    - g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
      - 1) Labor.
      - 2) Materials.
      - 3) Equipment.
  3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with Project Manual table of contents. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
    - 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.
  11. Copies of building permits.
  12. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
  13. Initial progress report.
  14. Report of preconstruction conference.
- 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.
9. Final liquidated damages settlement statement.

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:

<u>ITEM</u>	<u>FURNISHED BY</u>	<u>MOUNTED BY</u>	<u>LOW VOLTAGE WIRED BY</u>	<u>POWER WIRED &amp; CONNECTED BY</u>	<u>LOW VOLTAGE CONTROL CONNECTED BY</u>
Equipment motors	I	MI	MI	EI	--
Motor starters, contactors and overload heaters	MI	EI	EI	EI	MI
Fused and unfused disconnect switches	EI**	EI**	EI**	EI	--
Manual operating switches, speed switches, push-button stations and pilot lights	MI	EI	EI	EI	EI
Duct detectors	EI	MI	MI	EI	MI
Control relays and transformers	MI	MI	MI	EI	MI
Thermostats, time switches*	MI	MI	MI	EI	MI
Temperature control panels	MI	MI	MI	EI	MI
Motor and solenoid valves, damper motors, PE and EP switches	MI	MI	MI	--	MI
Refrigeration equipment, cooling tower and controls	MI	MI	MI	EI	MI
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
	<p>I = Installer of equipment requiring electrical service EI = Electrical Installer MI = Mechanical Installer</p> <p>* 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.)</p> <p>** Disconnects for AH units are factory mounted.</p> <p>***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.</p>				

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 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
    - a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
    - b. Coordinate the addition of trade-specific information to the coordination drawings by multiple subcontractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
    - c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
    - d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
    - e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
    - f. Indicate required installation sequences.
    - g. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect/Engineer indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
- B. Coordination Drawing Organization: Organize coordination drawings as follows:
1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings, where required, to adequately represent the Work.
  2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
  3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
  4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
  5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
  6. Mechanical and Plumbing Work: Show the following:
    - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
    - b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
    - c. Fire-rated enclosures around ductwork.
  7. Electrical Work: Show the following:

- a. Runs of vertical and horizontal conduit 1-1/4 inches in diameter and larger.
  - b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
  - c. Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.
  - d. Location of pull boxes and junction boxes, dimensioned from column center lines.
8. Fire-Protection System: Show the following:
- a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
9. Windows, Curtain Wall, and Exterior Wall Assembly Transition Work: Show all components of each adjacent wall or window system and all required compatible tie-ins between them including transition strips, flashings and sealants. Clearly identify each product, its configuration and its extent. Shop Drawings which only generically indicate adjacent construction and/or indicate "construction by others" will not be acceptable.
10. Review: Architect/Engineer will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect/Engineer determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect/Engineer will so inform Contractor, who shall make changes as directed and resubmit.
11. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 01 33 00 "Submittal Procedures."

#### 1.7 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.
    14. Space for response and signature by Architect/Engineer.
  - 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. 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.
- 1.8 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:
      - 1) Change Order Bulletin, Change Order Proposal and Change Orders.
      - 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:
    - a. Contract Documents.
    - b. Options.
    - c. Related RFIs.



- 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.
    - p. Compatibility of materials.
    - 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.
    - b. University Building Maintenance Operations (BMO) Representative.
    - 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.
    - c. University Building Maintenance Operations 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. Quality:
    - 1) Quality and work standards.
    - 2) Status of correction of deficient items.
    - 3) Progress cleaning.
    - 4) Field observations.
  - e. Status of submittals.
  - f. Status of RFIs.
  - g. Status of Changes including:
    - 1) Change Order Bulletins.
    - 2) Change Order Proposals.
    - 3) Change Orders.
    - 4) Pending claims and disputes.
  - h. Status of LEED documentation, for projects pursuing LEED certification.
  - i. 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 25<sup>th</sup> of each month.
- 1. Attendees:
    - a. University Project Manager.
    - b. Architect/Engineer.
    - c. Contractor's Project Manager, Superintendant 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

A/E: COORDINATE WITH UNIVERSITY PM AND EDIT THIS SECTION BASED ON PROJECT SIZE TO REFLECT THE APPROPRIATE TYPE CONSTRUCTION PROGRESS DOCUMENTATION REQUIRED.

#### 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. Daily construction reports.
  - 5. Monthly project status reports.
  - 6. Material location reports.
  - 7. Site condition reports.
  - 8. Special 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.
- B. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.
- C. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.

- D. Event: The starting or ending point of an activity.
- E. Float: The measure of leeway in starting and completing an activity.
  - 1. Float time is not for the exclusive use or benefit of either University or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
  - 2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
  - 3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.
- F. Resource Loading: The allocation of manpower necessary for the completion of an activity as scheduled.

#### 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.
- C. Qualification Data: For scheduling consultant or in-house scheduling expert.

#### 1.5 QUALITY ASSURANCE

- A. Scheduling Consultant Qualifications: An experienced specialist in CPM scheduling and reporting, with a minimum of 5 years experience and capability of producing CPM reports and diagrams within 24 hours of Architect/Engineer's request.
- B. 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.
- G. 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.

## 2.2 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.
  12. Emergency procedures.
  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.

Retain the following paragraph for Large Projects only.

- B. Monthly Project Status Report: Prepare a monthly project status report including the following:
1. Current status of Project:
    - a. Schedule.
    - b. Cost.
    - c. MBE and WBE participation, as applicable.
    - d. RFI's.
    - e. Submittals.
    - f. Manpower.
    - g. Safety.
  2. Narrative of progress achieved in previous month, activities anticipated for the next month, and issues affecting the rate of progress.
  3. Progress photographs in accordance with Section 01 32 33 "Photographic Documentation."
- C. Material Location Reports: At monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site. Indicate the following categories for stored materials:
1. Material stored prior to previous report and remaining in storage.
  2. Material stored prior to previous report and since removed from storage and installed.
  3. Material stored following previous report and remaining in storage.
- D. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information.



Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

## 2.3 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 32 33 - PHOTOGRAPHIC 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 the following:
  - 1. Preconstruction photographs.
  - 2. Periodic construction photographs.
  - 3. Final completion construction photographs.
- B. Related Requirements:
  - 1. Section 01 33 00 "Submittal Procedures" for submitting photographic documentation.
  - 2. Section 01 77 00 "Closeout Procedures" for submitting photographic documentation as project record documents at Project closeout.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For photographer.
- B. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.
- C. Digital Photographs: Submit image files within three business days of taking photographs.
  - 1. Digital Camera: Minimum sensor resolution of 12 megapixels.
  - 2. Format: Minimum 3200 by 2400 pixels, in unaltered original files, with same aspect ratio as the sensor, uncropped, date and time stamped, in folder named by date of photograph, accompanied by key plan file.
  - 3. Identification: Provide the following information with each image description in file metadata tag:
    - a. Name of Project.
    - b. Name and contact information for photographer.
    - c. Name of Architect/Engineer.
    - d. Name of Contractor.
    - e. Date photograph was taken.
    - f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
    - g. Unique sequential identifier keyed to accompanying key plan.

#### 1.4 QUALITY ASSURANCE

- A. Photographer Qualifications: An individual who has been regularly engaged as a professional photographer of construction projects for not less than three years.

#### 1.5 USAGE RIGHTS

- A. Obtain and transfer copyright usage rights from photographer to University for unlimited reproduction of photographic documentation.

### PART 2 - PRODUCTS

#### 2.1 PHOTOGRAPHIC MEDIA

- A. Digital Images: Provide images in JPG format, produced by a digital camera with minimum sensor size of 12 megapixels, and at an image resolution of not less than 3200 by 2400 pixels.

### PART 3 - EXECUTION

#### 3.1 CONSTRUCTION PHOTOGRAPHS

- A. Photographer: Engage a qualified photographer to take construction photographs.
- B. General: Take photographs using the maximum range of depth of field, and that are in focus, to clearly show the Work. Photographs with blurry or out-of-focus areas will not be accepted.
  - 1. Maintain key plan with each set of construction photographs that identifies each photographic location.
- C. Digital Images: Submit digital images exactly as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.
  - 1. Date and Time: Include date and time in file name for each image.
  - 2. Field Office Images: Maintain one set of images accessible in the field office at Project site, available at all times for reference. Identify images in the same manner as those submitted to Architect/Engineer.
- D. Preconstruction Photographs: Before starting construction, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Architect/Engineer.
  - 1. Flag construction limits before taking construction photographs.
  - 2. Take **20** photographs to show existing conditions adjacent to property before starting the Work.
  - 3. Take **20** photographs of existing buildings either on or adjoining property to accurately record physical conditions at start of construction.
  - 4. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.

- E. Periodic Construction Photographs: Take **20** photographs monthly, coinciding with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.
- F. Architect/Engineer-Directed Construction Photographs: From time to time, Architect/Engineer will instruct photographer about number and frequency of photographs and general directions on vantage points. Select actual vantage points and take photographs to show the status of construction and progress since last photographs were taken.
- G. Final Completion Construction Photographs: Take **20** color photographs after date of Substantial Completion for submission as project record documents. Architect/Engineer will inform photographer of desired vantage points.
  - 1. Do not include date stamp.
- H. Additional Photographs: University through Architect/Engineer may request photographs in addition to periodic photographs specified. Additional photographs will be paid for by Change Order and are not included in the Contract Sum.
  - 1. Three business days' notice will be given, where feasible.
  - 2. In emergency situations, take additional photographs within 24 hours of request.
  - 3. Circumstances that could require additional photographs include, but are not limited to, the following:
    - a. Special events planned at Project site.
    - b. Immediate follow-up when on-site events result in construction damage or losses.
    - c. Photographs to be taken at fabrication locations away from Project site. These photographs are not subject to unit prices or unit-cost allowances.
    - d. Substantial Completion of a major phase or component of the Work.
    - e. Extra record photographs at time of final acceptance.
    - f. University's request for special publicity photographs.

**END OF SECTION 01 32 33**

## 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.
  - 6. List of Subcontractors.
  - 7. Schedule of Values.
  - 8. Inspection and test results.
  - 9. Closeout documents.
  - 10. Coordination drawings.
  - 11. Street and Storm Water Quality Management Plan.

12. Indoor Air Quality Management Plan.

- C. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.
- D. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

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.
    - 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 format.**
    - 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. 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.
  4. Transmittal Form for Electronic Submittals: Use PDF acceptable to University, containing the following information:
    - a. Project name.
    - b. Date.
    - c. Name and address of Architect/Engineer.
    - d. Name and address of Contractor.
    - e. Name of firm or entity that prepared submittal.
    - f. Names of subcontractor, manufacturer, and supplier.
    - g. Category and type of submittal.

- h. Submittal purpose and description.
  - i. Specification Section number and title.
  - j. Specification paragraph number or drawing designation and generic name for each of multiple items.
  - k. Drawing number and detail references, as appropriate.
  - l. Location(s) where product is to be installed, as appropriate.
  - m. Related physical samples submitted directly.
  - n. Indication of full or partial submittal.
  - o. Transmittal number.
  - p. Submittal and transmittal distribution record.
  - q. Other necessary identification.
  - r. Contractor's certification that information complies with Contract Document requirements.
  - s. Remarks.
- E. Options: Identify options requiring selection by Architect/Engineer.
- F. 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.
- G. Contractor Certification: On transmittal include Contractor's certification that information complies with Contract Document requirements.
- H. 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.
- I. 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.
- J. 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.
- K. 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."
- L. 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. 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.



2. 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.
  3. 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.
  6. Confirm compliance of Product Data with requirements of Contract Documents. Submit cover letter indicating Contractor's certification of compliance.
  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 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.

## 2.3 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."
- 9) Comply with current "Asbestos-Contaminated Soil Management Standard Operating Procedure Document, University of Colorado Anschutz Medical Campus" during excavation operations.

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 is 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

**Project** \_\_\_\_\_

**Completed by:** \_\_\_\_\_  
(Name & Company)

**Date:** \_\_\_\_\_

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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.





- ☐ 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: \_\_\_\_\_  
(Contractor)

Date: \_\_\_\_\_



- ☐ 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: \_\_\_\_\_  
(Contractor)

Date: \_\_\_\_\_

## SECTION 01 40 00 - QUALITY 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 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. 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.

- D. 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.
- E. Source Quality-Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.
- F. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- G. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- H. 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).
- I. 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 N/A

#### 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.
  - 2. Main wind-force-resisting system or a wind-resisting component listed in the wind-force-resisting 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.
  - 7. Identification of product and Specification Section.
  - 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:
    - a. Company: State of Colorado master electrician license.
    - b. On-site electricians: State of Colorado journeyman license.
  3. Plumbing Contractors:
    - a. Company: State of Colorado master plumbers license.
    - b. On-site plumbers: State of Colorado journeyman license.
    - 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.
  - 3. Independent Agency: Meeting "Recommended Requirements for Independent Laboratory Qualifications" published by American Council for Independent Laboratories.
  - 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.

## 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.
- F. Testing Agency Responsibilities: Cooperate with Architect/Engineer and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
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.
  3. Cast-in-place concrete.
  4. Precast concrete.
  5. Post-tensioned concrete tendons.

6. Masonry.
7. Structural steel field welds and bolted connections.
8. Spray-applied fireproofing.
9. Built-up roof cutouts.
10. Asphaltic concrete paving.
11. Foundation drainage systems.
12. Drainage structures and piping.
13. Waterproofing.
14. Air barriers.
15. Fluid applied membranes.
16. Thermal imaging.
17. Curtain wall, window, and door field testing.
18. Ceiling hanger wire pull-out.
19. Electrical resistance of static-control resilient flooring.
20. Field sound testing of operable partitions.
21. Elevator safety.
22. Fan vibration.

**END OF SECTION 01 40 00**

## SECTION 01 41 00 - REGULATORY 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:
  - 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.

##### 1. The Manual of Guidelines and Standards for Construction Projects

- a. <http://ucdenver.edu/about/departments/FacilitiesManagement/FacilitiesProjects/Pages/GuidelinesStandards.aspx>

2. Colorado Rules and Regulations pertaining to Radiation Control, 6 CCR 1007 Part 1-20.
3. Colorado Rules and Regulations pertaining Air Quality Control Commission Regulations, 5 CCR 1001-10, Part B "Asbestos Control."
4. Colorado Rules and Regulations pertaining to Solid Waste, 6 CCR 1007-2.
5. Colorado Rules and Regulations pertaining to Hazardous Waste, 6 CCR 1007-3.
6. Federal Hazardous Waste Regulations, 40 CFR, Parts 260 through 264.
7. Federal Clean Water Act (CWA) is 33 U.S.C § 1251 et seq. (1972).
8. University of Colorado Denver | Anschutz Medical Campus, Asbestos Contaminated Soil Management, Standard Operating Procedure (SOP) Document.
9. NFPA 30: Flammable and Combustible Liquids Code.
10. NFPA 45: Standard on Fire Protection for Laboratories Using Chemicals.
11. NFPA 72: National Fire Alarm and Signaling Code.
12. Life Safety Code (NFPA 101) – latest edition.

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

##### 13. ANSI/AIHA Z9.5 Laboratory Ventilation – latest edition.



- a. <http://www.aiha.org/insideaiha/standards/Pages/ANSIZ9.aspx>
  - 14. ANSI/AIHA Z9.6 Exhaust Systems for Grinding, Buffing and Polishing – latest edition.
    - a. <http://www.aiha.org/insideaiha/standards/Pages/ANSIZ9.aspx>
  - 15. ANSI/AIHA Z9.10 Fundamentals Governing the Design and Operation of Dilution Ventilation Systems in Industrial Occupancies – latest edition.
    - a. <http://www.aiha.org/insideaiha/standards/Pages/ANSIZ9.aspx>
  - 16. ANSI/ASHRAE/ASHE Standard 170 – Ventilation of Healthcare Facilities – latest edition.
  - 17. ASHRAE 62.1 – Ventilation for Acceptable Indoor Air Quality.
  - 18. OSHA “Safety and Health Regulation for Construction” (29 CFR 1926).
  - 19. OSHA “Occupational Safety and Health Standards” (29 CFR 1910).
  - 20. American Institute of Architects, Academy of Architecture for Health (AIA AAHA) and Facility Guidelines Institute (FGI), Guidelines for Design and Construction of Hospital and Healthcare Facilities – latest edition (FOR PATIENT CARE AREAS ONLY).
  - 21. CDC-NIH Biosafety in Microbiological and Biomedical Laboratories (BMBL); latest edition.
  - 22. NIH Design Requirements Manual (DRM) – latest edition.
    - a. <http://orf.nih.gov/PoliciesAndGuidelines/BiomedicalandAnimalResearchFacilitiesDesignPoliciesandGuidelines/DesignRequirementsManualPDF.htm>
  - 23. NIH Guidelines for Research Involving Recombinant DNA Molecules – latest edition.
  - 24. ILAR Guide for Care and Use of Laboratory Animals - latest edition.
  - 25. National Research Council of the National Academies, Institute for Laboratory Animal Research, Division on Earth and Life Studies: Guide for the Care and Use of Laboratory Animals - latest edition.
  - 26. Uniform Federal Accessibility Standards (UFAS) – latest edition.
  - 27. Metro Wastewater District’s Rules and Regulations, (Sections 6.17 [6.13, 6.14] and 6.18).
  - 28. City of Aurora Asphalt and Paving Standards - 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** "General Requirements": Provisions and requirements of all Division 01 Sections as they apply to all aspects of the Work.

- H. "Guarantee": The narrow definition of the term "warranty" applying to both "warranty" and "guarantee" which terms are used interchangeably.
- I. "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."
- J. "Redundant": 2N system. The level of redundancy is determined by design.
- K. "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.
- L. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- M. "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.
- N. "Owner": Principal Representative and/or University.
- O. "Provide": Furnish and install, complete and ready for the intended use.
- P. "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.
- Q. "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.
- R. "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.

AABC	Associated Air Balance Council www.aabc.com	(202) 737-0202
AAMA	American Architectural Manufacturers Association www.aamanet.org	(847) 303-5664
AASHTO	American Association of State Highway and Transportation Officials www.transportation.org	(202) 624-5800
AATCC	American Association of Textile Chemists and Colorists www.aatcc.org	(919) 549-8141
ABMA	American Bearing Manufacturers Association www.americanbearings.org	(202) 367-1155
ACI	American Concrete Institute (Formerly: ACI International) www.concrete.org	(248) 848-3700
ACPA	American Concrete Pipe Association www.concrete-pipe.org	(972) 506-7216
AEIC	Association of Edison Illuminating Companies, Inc. (The) www.aeic.org	(205) 257-2530
AF&PA	American Forest & Paper Association	(800) 878-8878

	<a href="http://www.afandpa.org">www.afandpa.org</a>	(202) 463-2700
AGA	American Gas Association <a href="http://www.aga.org">www.aga.org</a>	(202) 824-7000
AHAM	Association of Home Appliance Manufacturers <a href="http://www.aham.org">www.aham.org</a>	(202) 872-5955
AHRI	Air-Conditioning, Heating, and Refrigeration Institute (The) <a href="http://www.ahrinet.org">www.ahrinet.org</a>	(703) 524-8800
AI	Asphalt Institute <a href="http://www.asphaltinstitute.org">www.asphaltinstitute.org</a>	(859) 288-4960
AIA	American Institute of Architects (The) <a href="http://www.aia.org">www.aia.org</a>	(800) 242-3837 (202) 626-7300
AISC	American Institute of Steel Construction <a href="http://www.aisc.org">www.aisc.org</a>	(800) 644-2400 (312) 670-2400
AISI	American Iron and Steel Institute <a href="http://www.steel.org">www.steel.org</a>	(202) 452-7100
AITC	American Institute of Timber Construction <a href="http://www.aitc-glulam.org">www.aitc-glulam.org</a>	(303) 792-9559
AMCA	Air Movement and Control Association International, Inc. <a href="http://www.amca.org">www.amca.org</a>	(847) 394-0150
ANSI	American National Standards Institute <a href="http://www.ansi.org">www.ansi.org</a>	(202) 293-8020
AOSA	Association of Official Seed Analysts, Inc. <a href="http://www.aosaseed.com">www.aosaseed.com</a>	(607) 256-3313
APA	APA - The Engineered Wood Association <a href="http://www.apawood.org">www.apawood.org</a>	(253) 565-6600
APA	Architectural Precast Association <a href="http://www.archprecast.org">www.archprecast.org</a>	(239) 454-6989
API	American Petroleum Institute <a href="http://www.api.org">www.api.org</a>	(202) 682-8000
ARI	Air-Conditioning & Refrigeration Institute (See AHRI)	
ARI	American Refrigeration Institute (See AHRI)	
ARMA	Asphalt Roofing Manufacturers Association <a href="http://www.asphaltroofing.org">www.asphaltroofing.org</a>	(202) 207-0917
ASCE	American Society of Civil Engineers <a href="http://www.asce.org">www.asce.org</a>	(800) 548-2723 (703) 295-6300

ASCE/SEI	American Society of Civil Engineers/Structural Engineering Institute (See ASCE)	
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers www.ashrae.org	(800) 527-4723 (404) 636-8400
ASME	ASME International (American Society of Mechanical Engineers) www.asme.org	(800) 843-2763 (973) 882-1170
ASSE	American Society of Safety Engineers (The) www.asse.org	(847) 699-2929
ASSE	American Society of Sanitary Engineering www.asse-plumbing.org	(440) 835-3040
ASTM	ASTM International (American Society for Testing and Materials International) www.astm.org	(610) 832-9500
ATIS	Alliance for Telecommunications Industry Solutions www.atis.org	(202) 628-6380
AWEA	American Wind Energy Association www.awea.org	(202) 383-2500
AWI	Architectural Woodwork Institute www.awinet.org	(571) 323-3636
AWMAC	Architectural Woodwork Manufacturers Association of Canada www.awmac.com	(403) 453-7387
AWPA	American Wood Protection Association (Formerly: American Wood-Preservers' Association) www.awpa.com	(205) 733-4077
AWS	American Welding Society www.aws.org	(800) 443-9353 (305) 443-9353
AWWA	American Water Works Association www.awwa.org	(800) 926-7337 (303) 794-7711
BHMA	Builders Hardware Manufacturers Association www.buildershardware.com	(212) 297-2122
BIA	Brick Industry Association (The) www.gobrick.com	(703) 620-0010
BICSI	BICSI, Inc. www.bicsi.org	(800) 242-7405 (813) 979-1991
BIFMA	BIFMA International (Business and Institutional Furniture Manufacturer's Association) www.bifma.com	(616) 285-3963

BISSC	Baking Industry Sanitation Standards Committee <a href="http://www.bissc.org">www.bissc.org</a>	(866) 342-4772
BOCA	BOCA (Building Officials and Code Administrators International Inc.) (See ICC)	
BWF	Badminton World Federation (Formerly: International Badminton Federation) <a href="http://www.bwfbadminton.org">www.bwfbadminton.org</a>	60 3 9283 7155
CDA	Copper Development Association <a href="http://www.copper.org">www.copper.org</a>	(800) 232-3282 (212) 251-7200
CEA	Canadian Electricity Association <a href="http://www.electricity.ca">www.electricity.ca</a>	(613) 230-9263
CEA	Consumer Electronics Association <a href="http://www.ce.org">www.ce.org</a>	(866) 858-1555 (703) 907-7600
CFFA	Chemical Fabrics & Film Association, Inc. <a href="http://www.chemicalfabricsandfilm.com">www.chemicalfabricsandfilm.com</a>	(216) 241-7333
CFSEI	Cold-Formed Steel Engineers Institute <a href="http://www.cfsei.org">www.cfsei.org</a>	(866) 465-4732 (202) 263-4488
CGA	Compressed Gas Association <a href="http://www.cganet.com">www.cganet.com</a>	(703) 788-2700
CIMA	Cellulose Insulation Manufacturers Association <a href="http://www.cellulose.org">www.cellulose.org</a>	(888) 881-2462 (937) 222-2462
CISCA	Ceilings & Interior Systems Construction Association <a href="http://www.cisca.org">www.cisca.org</a>	(630) 584-1919
CISPI	Cast Iron Soil Pipe Institute <a href="http://www.cispi.org">www.cispi.org</a>	(404) 622-0073
CLFMI	Chain Link Fence Manufacturers Institute <a href="http://www.chainlinkinfo.org">www.chainlinkinfo.org</a>	(301) 596-2583
CPA	Composite Panel Association <a href="http://www.pbmdf.com">www.pbmdf.com</a>	(703) 724-1128
CRI	Carpet and Rug Institute (The) <a href="http://www.carpet-rug.org">www.carpet-rug.org</a>	(706) 278-3176
CRRC	Cool Roof Rating Council <a href="http://www.coolroofs.org">www.coolroofs.org</a>	(866) 465-2523 (510) 485-7175
CRSI	Concrete Reinforcing Steel Institute <a href="http://www.crsi.org">www.crsi.org</a>	(800) 328-6306 (847) 517-1200
CSA	Canadian Standards Association <a href="http://www.csa.ca">www.csa.ca</a>	(800) 463-6727 (416) 747-4000

CSA	CSA International (Formerly: IAS - International Approval Services) www.csa-international.org	(866) 797-4272 (416) 747-4000
CSI	Construction Specifications Institute (The) www.csinet.org	(800) 689-2900 (703) 684-0300
CSSB	Cedar Shake & Shingle Bureau www.cedarbureau.org	(604) 820-7700
CTI	Cooling Technology Institute (Formerly: Cooling Tower Institute) www.cti.org	(281) 583-4087
CWC	Composite Wood Council (See CPA)	
DASMA	Door and Access Systems Manufacturers Association www.dasma.com	(216) 241-7333
DHI	Door and Hardware Institute www.dhi.org	(703) 222-2010
ECA	Electronic Components Association www.ec-central.org	(703) 907-8024
ECAMA	Electronic Components Assemblies & Materials Association (See ECA)	
EIA	Electronic Industries Alliance (See TIA)	
EIMA	EIFS Industry Members Association www.eima.com	(800) 294-3462 (703) 538-1616
EJMA	Expansion Joint Manufacturers Association, Inc. www.ejma.org	(914) 332-0040
ESD	ESD Association (Electrostatic Discharge Association) www.esda.org	(315) 339-6937
ESTA	Entertainment Services and Technology Association (See PLASA)	
EVO	Efficiency Valuation Organization www.evo-world.org	(415) 367-3643 44 20 88 167 857
FIBA	Fédération Internationale de Basketball (The International Basketball Federation) www.fiba.com	41 22 545 00 00
FIVB	Fédération Internationale de Volleyball (The International Volleyball Federation) www.fivb.org	41 21 345 35 45



FM Approvals	FM Approvals LLC www.fmglobal.com	(781) 762-4300
FM Global	FM Global (Formerly: FMG - FM Global) www.fmglobal.com	(401) 275-3000
FRSA	Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc. www.floridarooft.com	(407) 671-3772
FSA	Fluid Sealing Association www.fluidsealing.com	(610) 971-4850
FSC	Forest Stewardship Council U.S. www.fscus.org	(612) 353-4511
GA	Gypsum Association www.gypsum.org	(301) 277-8686
GANA	Glass Association of North America www.glasswebsite.com	(785) 271-0208
GS	Green Seal www.greenseal.org	(202) 872-6400
HI	Hydraulic Institute www.pumps.org	(973) 267-9700
HI/GAMA	Hydronics Institute/Gas Appliance Manufacturers Association (See AHRI)	
HMMA	Hollow Metal Manufacturers Association (See NAAMM)	
HPVA	Hardwood Plywood & Veneer Association www.hpva.org	(703) 435-2900
HPW	H. P. White Laboratory, Inc. www.hpwhite.com	(410) 838-6550
IAPSC	International Association of Professional Security Consultants www.iapsc.org	(415) 536-0288
IAS	International Approval Services (See CSA)	
ICBO	International Conference of Building Officials (See ICC)	
ICC	International Code Council www.iccsafe.org	(888) 422-7233 (202) 370-1800
ICEA	Insulated Cable Engineers Association, Inc. www.icea.net	(770) 830-0369

ICPA	International Cast Polymer Alliance <a href="http://www.icpa-hq.org">www.icpa-hq.org</a>	(703) 525-0511
ICRI	International Concrete Repair Institute, Inc. <a href="http://www.icri.org">www.icri.org</a>	(847) 827-0830
IEC	International Electrotechnical Commission <a href="http://www.iec.ch">www.iec.ch</a>	41 22 919 02 11
IEEE	Institute of Electrical and Electronics Engineers, Inc. (The) <a href="http://www.ieee.org">www.ieee.org</a>	(212) 419-7900
IES	Illuminating Engineering Society (Formerly: Illuminating Engineering Society of North America) <a href="http://www.ies.org">www.ies.org</a>	(212) 248-5000
IESNA	Illuminating Engineering Society of North America (See IES)	
IENT	Institute of Environmental Sciences and Technology <a href="http://www.ient.org">www.ient.org</a>	(847) 981-0100
IGMA	Insulating Glass Manufacturers Alliance <a href="http://www.igmaonline.org">www.igmaonline.org</a>	(613) 233-1510
IGSHPA	International Ground Source Heat Pump Association <a href="http://www.igshpa.okstate.edu">www.igshpa.okstate.edu</a>	(405) 744-5175
ILI	Indiana Limestone Institute of America, Inc. <a href="http://www.ili.ai.com">www.ili.ai.com</a>	(812) 275-4426
Intertek	Intertek Group (Formerly: ETL SEMCO; Intertek Testing Service NA) <a href="http://www.intertek.com">www.intertek.com</a>	(800) 967-5352
ISA	International Society of Automation (The) (Formerly: Instrumentation, Systems, and Automation Society) <a href="http://www.isa.org">www.isa.org</a>	(919) 549-8411
ISAS	Instrumentation, Systems, and Automation Society (The) (See ISA)	
ISFA	International Surface Fabricators Association (Formerly: International Solid Surface Fabricators Association) <a href="http://www.isfanow.org">www.isfanow.org</a>	(877) 464-7732 (801) 341-7360
ISO	International Organization for Standardization <a href="http://www.iso.org">www.iso.org</a>	41 22 749 01 11
ISSFA	International Solid Surface Fabricators Association (See ISFA)	
ITU	International Telecommunication Union <a href="http://www.itu.int/home">www.itu.int/home</a>	41 22 730 51 11

KCMA	Kitchen Cabinet Manufacturers Association <a href="http://www.kcma.org">www.kcma.org</a>	(703) 264-1690
LMA	Laminating Materials Association (See CPA)	
LPI	Lightning Protection Institute <a href="http://www.lightning.org">www.lightning.org</a>	(800) 488-6864
MBMA	Metal Building Manufacturers Association <a href="http://www.mbma.com">www.mbma.com</a>	(216) 241-7333
MCA	Metal Construction Association <a href="http://www.metalconstruction.org">www.metalconstruction.org</a>	(847) 375-4718
MFMA	Maple Flooring Manufacturers Association, Inc. <a href="http://www.maplefloor.org">www.maplefloor.org</a>	(888) 480-9138
MFMA	Metal Framing Manufacturers Association, Inc. <a href="http://www.metalframingmfg.org">www.metalframingmfg.org</a>	(312) 644-6610
MHIA	Material Handling Industry of America <a href="http://www.mhia.org">www.mhia.org</a>	(800) 345-1815 (704) 676-1190
MIA	Marble Institute of America <a href="http://www.marble-institute.com">www.marble-institute.com</a>	(440) 250-9222
MMPA	Moulding & Millwork Producers Association (Formerly: Wood Moulding & Millwork Producers Association) <a href="http://www.wmmpa.com">www.wmmpa.com</a>	(800) 550-7889 (530) 661-9591
MPI	Master Painters Institute <a href="http://www.paintinfo.com">www.paintinfo.com</a>	(888) 674-8937 (604) 298-7578
MSS	Manufacturers Standardization Society of The Valve and Fittings Industry Inc. <a href="http://www.mss-hq.org">www.mss-hq.org</a>	(703) 281-6613
NAAMM	National Association of Architectural Metal Manufacturers <a href="http://www.naamm.org">www.naamm.org</a>	(630) 942-6591
NACE	NACE International (National Association of Corrosion Engineers International) <a href="http://www.nace.org">www.nace.org</a>	(800) 797-6223 (281) 228-6200
NADCA	National Air Duct Cleaners Association <a href="http://www.nadca.com">www.nadca.com</a>	(202) 737-2926
NAIMA	North American Insulation Manufacturers Association <a href="http://www.naima.org">www.naima.org</a>	(703) 684-0084
NBGQA	National Building Granite Quarries Association, Inc. <a href="http://www.nbgqa.com">www.nbgqa.com</a>	(800) 557-2848
NCAA	National Collegiate Athletic Association (The) <a href="http://www.ncaa.org">www.ncaa.org</a>	(317) 917-6222

NCMA	National Concrete Masonry Association www.ncma.org	(703) 713-1900
NEBB	National Environmental Balancing Bureau www.nebb.org	(301) 977-3698
NECA	National Electrical Contractors Association www.necanet.org	(301) 657-3110
NeLMA	Northeastern Lumber Manufacturers Association www.nelma.org	(207) 829-6901
NEMA	National Electrical Manufacturers Association www.nema.org	(703) 841-3200
NETA	InterNational Electrical Testing Association www.netaworld.org	(888) 300-6382 (269) 488-6382
NFHS	National Federation of State High School Associations www.nfhs.org	(317) 972-6900
NFPA	NFPA (National Fire Protection Association) www.nfpa.org	(800) 344-3555 (617) 770-3000
NFPA	NFPA International (See NFPA)	
NFRC	National Fenestration Rating Council www.nfrc.org	(301) 589-1776
NHLA	National Hardwood Lumber Association www.nhla.com	(800) 933-0318 (901) 377-1818
NLGA	National Lumber Grades Authority www.nlga.org	(604) 524-2393
NOFMA	National Oak Flooring Manufacturers Association (See NWFA)	
NOMMA	National Ornamental & Miscellaneous Metals Association www.nomma.org	(888) 516-8585
NRCA	National Roofing Contractors Association www.nrca.net	(800) 323-9545 (847) 299-9070
NRMCA	National Ready Mixed Concrete Association www.nrmca.org	(888) 846-7622 (301) 587-1400
NSF	NSF International (National Sanitation Foundation International) www.nsf.org	(800) 673-6275 (734) 769-8010
NSPE	National Society of Professional Engineers www.nspe.org	(703) 684-2800

NSSGA	National Stone, Sand & Gravel Association www.nssga.org	(800) 342-1415 (703) 525-8788
NTMA	National Terrazzo & Mosaic Association, Inc. (The) www.ntma.com	(800) 323-9736
NWFA	National Wood Flooring Association www.nwfa.org	(800) 422-4556 (636) 519-9663
PCI	Precast/Prestressed Concrete Institute www.pci.org	(312) 786-0300
PDI	Plumbing & Drainage Institute www.pdionline.org	(800) 589-8956 (978) 557-0720
PLASA	PLASA (Formerly: ESTA - Entertainment Services and Technology Association) www.plasa.org	(212) 244-1505
RCSC	Research Council on Structural Connections www.boltcouncil.org	
RFCI	Resilient Floor Covering Institute www.rfci.com	(706) 882-3833
RIS	Redwood Inspection Service www.redwoodinspection.com	(925) 935-1499
SAE	SAE International (Society of Automotive Engineers) www.sae.org	(877) 606-7323 (724) 776-4841
SBCCI	Southern Building Code Congress International, Inc. (See ICC)	
SCTE	Society of Cable Telecommunications Engineers www.scte.org	(800) 542-5040 (610) 363-6888
SDI	Steel Deck Institute www.sdi.org	(847) 458-4647
SDI	Steel Door Institute www.steeldoor.org	(440) 899-0010
SEFA	Scientific Equipment and Furniture Association www.sefalabs.com	(877) 294-5424 (516) 294-5424
SEI/ASCE	Structural Engineering Institute/American Society of Civil Engineers (See ASCE)	
SIA	Security Industry Association www.siaonline.org	(866) 817-8888 (703) 683-2075

SJI	Steel Joist Institute www.steeljoist.org	(843) 293-1995
SMA	Screen Manufacturers Association www.smainfo.org	(773) 636-0672
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association www.smacna.org	(703) 803-2980
SMPTE	Society of Motion Picture and Television Engineers www.smpte.org	(914) 761-1100
SPFA	Spray Polyurethane Foam Alliance www.sprayfoam.org	(800) 523-6154
SPIB	Southern Pine Inspection Bureau www.spib.org	(850) 434-2611
SPRI	Single Ply Roofing Industry www.spri.org	(781) 647-7026
SRCC	Solar Rating and Certification Corporation www.solar-rating.org	(321) 638-1537
SSINA	Specialty Steel Industry of North America www.ssina.com	(800) 982-0355 (202) 342-8630
SSPC	SSPC: The Society for Protective Coatings www.sspc.org	(877) 281-7772 (412) 281-2331
STI	Steel Tank Institute www.steeltank.com	(847) 438-8265
SWI	Steel Window Institute www.steelwindows.com	(216) 241-7333
SWPA	Submersible Wastewater Pump Association www.swpa.org	(847) 681-1868
TCA	Tilt-Up Concrete Association www.tilt-up.org	(319) 895-6911
TCNA	Tile Council of North America, Inc. (Formerly: Tile Council of America) www.tileusa.com	(864) 646-8453
TEMA	Tubular Exchanger Manufacturers Association, Inc. www.tema.org	(914) 332-0040
TIA	Telecommunications Industry Association (Formerly: TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance) www.tiaonline.org	(703) 907-7700
TIA/EIA	Telecommunications Industry Association/Electronic Industries Alliance	

(See TIA)

TMS	The Masonry Society www.masonrysociety.org	(303) 939-9700
TPI	Truss Plate Institute www.tpinst.org	(703) 683-1010
TPI	Turfgrass Producers International www.turfgrassod.org	(800) 405-8873 (847) 649-5555
TRI	Tile Roofing Institute www.tilerroofing.org	(312) 670-4177
UBC	Uniform Building Code (See ICC)	
UL	Underwriters Laboratories Inc. www.ul.com	(877) 854-3577
UNI	Uni-Bell PVC Pipe Association www.uni-bell.org	(972) 243-3902
USAV	USA Volleyball www.usavolleyball.org	(888) 786-5539 (719) 228-6800
USGBC	U.S. Green Building Council www.usgbc.org	(800) 795-1747
USITT	United States Institute for Theatre Technology, Inc. www.usitt.org	(800) 938-7488 (315) 463-6463
WASTEC	Waste Equipment Technology Association www.wastec.org	(800) 424-2869 (202) 244-4700
WCLIB	West Coast Lumber Inspection Bureau www.wclib.org	(800) 283-1486 (503) 639-0651
WCMA	Window Covering Manufacturers Association www.wcmanet.org	(212) 297-2122
WDMA	Window & Door Manufacturers Association www.wdma.com	(800) 223-2301 (312) 321-6802
WI	Woodwork Institute (Formerly: WIC - Woodwork Institute of California) www.wicnet.org	(916) 372-9943
WMMPA	Wood Moulding & Millwork Producers Association (See MMPA)	
WSRCA	Western States Roofing Contractors Association www.wsrca.com	(800) 725-0333 (650) 938-5441
WWPA	Western Wood Products Association www.wwpa.org	(503) 224-3930

- 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. www.din.de	49 30 2601-0
IAPMO	International Association of Plumbing and Mechanical Officials www.iapmo.org	(909) 472-4100
ICC	International Code Council www.iccsafe.org	(888) 422-7233
ICC-ES	ICC Evaluation Service, LLC www.icc-es.org	(800) 423-6587 (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 www.usace.army.mil	(202) 761-0011
CPSC	Consumer Product Safety Commission www.cpsc.gov	(800) 638-2772 (301) 504-7923
DOC	Department of Commerce National Institute of Standards and Technology www.nist.gov	(301) 975-4040
DOD	Department of Defense http://dodssp.daps.dla.mil	(215) 697-2664
DOE	Department of Energy www.energy.gov	(202) 586-9220
EPA	Environmental Protection Agency www.epa.gov	(202) 272-0167
FAA	Federal Aviation Administration www.faa.gov	(866) 835-5322
FG	Federal Government Publications www.gpo.gov	(202) 512-1800
GSA	General Services Administration www.gsa.gov	(800) 488-3111 (202) 619-8925
HUD	Department of Housing and Urban Development www.hud.gov	(202) 708-1112
LBL	Lawrence Berkeley National Laboratory Environmental Energy Technologies Division http://eetd.lbl.gov	(510) 486-4000



OSHA	Occupational Safety & Health Administration <a href="http://www.osha.gov">www.osha.gov</a>	(800) 321-6742
SD	Department of State <a href="http://www.state.gov">www.state.gov</a>	(202) 647-4000
TRB	Transportation Research Board National Cooperative Highway Research Program <a href="http://www.trb.org">www.trb.org</a>	(202) 334-2934
USDA	Department of Agriculture Agriculture Research Service U.S. Salinity Laboratory <a href="http://www.ars.usda.gov">www.ars.usda.gov</a>	(202) 720-3656
USDA	Department of Agriculture Rural Utilities Service <a href="http://www.usda.gov">www.usda.gov</a>	(202) 720-2791
USDJ	Department of Justice Office of Justice Programs National Institute of Justice <a href="http://www.ojp.usdoj.gov">www.ojp.usdoj.gov</a>	(202) 307-0703
USP	U.S. Pharmacopeia <a href="http://www.usp.org">www.usp.org</a>	(800) 227-8772 (301) 881-0666
USPS	United States Postal Service <a href="http://www.usps.com">www.usps.com</a>	(202) 268-2000

- 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.

CFR	Code of Federal Regulations Available from Government Printing Office <a href="http://www.gpo.gov/fdsys">www.gpo.gov/fdsys</a>	(866) 512-1800 (202) 512-1800
DOD	Department of Defense Military Specifications and Standards Available from Department of Defense Single Stock Point <a href="http://dodssp.daps.dla.mil">http://dodssp.daps.dla.mil</a>	(215) 697-2664
DSCC	Defense Supply Center Columbus (See FS)	
FED-STD	Federal Standard (See FS)	
FS	Federal Specification Available from Department of Defense Single Stock Point <a href="http://dodssp.daps.dla.mil">http://dodssp.daps.dla.mil</a>  Available from Defense Standardization Program	(215) 697-2664

CU Denver Anschutz  
ARTS Ft. Logan Reno Bldg 16

[www.dsp.dla.mil](http://www.dsp.dla.mil)

Available from General Services Administration (800) 488-3111  
[www.gsa.gov](http://www.gsa.gov) (202) 619-8925

Available from National Institute of Building Sciences/Whole Building  
Design Guide (202) 289-7800  
[www.wbdg.org/ccb](http://www.wbdg.org/ccb)

MILSPEC Military Specification and Standards  
(See DOD)

USAB United States Access Board (800) 872-2253  
[www.access-board.gov](http://www.access-board.gov) (202) 272-0080

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 50 00 - TEMPORARY FACILITIES AND CONTROLS

### 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 temporary utilities, support facilities, and security and protection facilities.
  - 1. Nothing in this Section is intended to limit types and amounts of temporary work required, and no omission from this Section will be recognized as an indication by Architect/Engineer that such temporary activity is not required for successful completion of the Work. The use of alternative facilities equivalent to those specified is the Contractor's option, subject to Architect/Engineer's and University acceptance.
- B. Related Requirements:
  - 1. Section 01 10 00 "Summary" for work restrictions and limitations on utility interruptions.
  - 2. Section 01 35 46 "Indoor Air Quality" for temporary facility work including HVAC, air filtration, moisture management, air filtration and dust control partitions required to comply with indoor air quality requirements during construction.

#### 1.3 USE CHARGES

- A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to, University's construction forces, Architect/Engineer, testing agencies, and authorities having jurisdiction.
- B. Use Charges: As follows:
  - 1. For new construction: Arrange for and pay for water, sewer, electric power, steam and chilled water use charges for utility usage by all entities for construction operations.
  - 2. For renovations of existing facilities: Arrange for and University will pay for all use charges.
- C. Temporary Metering: For all utility connection; sub-meter at point of connection to existing systems.
  - 1. Temporary utility meter must be approved by University Campus Energy Engineer.
  - 2. Meters shall be operational prior to any use of utility for temporary heating.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

- B. Erosion- and Sedimentation-Control Plan: Show compliance with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.
- C. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.
- D. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Identify further options if proposed measures are later determined to be inadequate. Include the following:
  - 1. Locations of dust-control partitions at each phase of work.
  - 2. HVAC system isolation schematic drawing.
  - 3. Location of proposed air-filtration system discharge.
  - 4. Waste handling procedures.
  - 5. Other dust-control measures.

#### 1.5 QUALITY ASSURANCE

- A. General: Comply with governing regulations and utility company regulations and recommendations for the construction of temporary facilities including, but not necessarily limited to, code compliances, permits, inspections, testing, health, safety, pollution and environmental compliances.
- B. Fire-safety: Comply with NFPA 421 "Standard for Safeguarding Construction, Alteration, and Demolition Operations."
- C. Safety: Comply with ANSI/ASSE A10 "Construction Package" series of safety construction standards.
- D. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- E. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.
- F. Accessible Temporary Egress: Where temporary accessible egress from existing buildings or portions thereof is provided, comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

#### 1.6 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before University's acceptance, regardless of previously assigned responsibilities.
- B. Conditions of Use: Keep temporary services and facilities clean and neat in appearance. Operate in a safe and efficient manner. Take necessary fire prevention measures. Do not overload facilities, or permit them to interfere with progress. Do not allow hazardous, dangerous or unsanitary conditions, or public nuisances to develop or persist on the site.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. General: Provide both new or used materials and equipment for temporary facilities, which are in substantially undamaged and serviceable condition. Provide types and qualities which are recognized in the construction industry as suitable for the intended use in each application. Comply with Utility Company requirements as applicable.

### 2.2 TEMPORARY FACILITIES

- A. Field Offices, General: N/A

### 2.3 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. Digital Camera: Minimum 12 megapixel; available in field office for use.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate, expand and modify facilities as required by progress of the Work.
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.
- C. Use qualified workers for the installation of temporary facilities.

### 3.2 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
  - 1. Arrange with utility company, University, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services. Comply with requirements in Section 01 10 00 "Summary" for existing utility disruption procedures.
- B. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
  - 1. Toilets: Use of University's existing toilet facilities is permitted on construction floor only.
  - 2. Supply and maintain toilet tissue, paper towels, paper cups and similar disposable materials as appropriate for each sanitary facility, and provide appropriate waste paper containers for used materials.

3. At Contractor's option, provide drinking water for construction personnel by either water-system-connected drinking fountains or by containerized tap dispensers with paper cups (or both).
- C. Heating: Provide temporary heating required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
1. HVAC Equipment: Unless University authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
    - a. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
    - b. Permanent HVAC System: If University authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return-air and exhaust grille in system and remove at end of construction. Clean and adjust HVAC system and put in new condition before Completion as required in Section 01 77 00 "Closeout Procedures".
- D. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.
1. Prior to commencing work, isolate the HVAC system in area where work is to be performed.
  2. Maintain dust partitions during the Work. Use vacuum collection attachments on dust-producing equipment. Isolate limited work within occupied areas using portable dust-containment devices.
  3. Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.
- E. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
1. Provide dehumidification systems when required to reduce substrate moisture levels to level required to allow installation or application of finishes.
- F. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
1. Provide temporary light to levels and as required by governing regulations but not less than minimum 5 foot-candle illumination in all areas accessible to workers during hours they are at the job; minimum 10 foot-candles for shop areas; 20 foot-candles or more where detailed or finishing work is being done, supplemented as may be required.
  2. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
  3. Install lighting for Project identification sign.
  4. Where permanent light fixtures have been used for temporary lighting, supply temporary lamps and replace with new lamps at time of Completion.
- G. Telephone Service: Provide temporary telephone service in Contractor's field office and distribute to each work station.

1. Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.

### 3.3 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:
- B. Traffic Controls: Comply with requirements of authorities having jurisdiction.
  1. Protect existing site improvements to remain including curbs, pavement, and utilities.
  2. Maintain access for fire-fighting equipment and access to fire hydrants.
- C. Parking: Comply with requirements in Section 01 10 00 "Summary."
- D. Project Signs: Provide Project signs at locations indicated or directed. Unauthorized signs are not permitted.
  1. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
    - a. Provide temporary, directional signs for construction personnel and visitors.
  2. Engage an experience sign painter to apply required colors and graphics in a neat and professional manner.
  3. Maintain and touchup signs so they are legible at all times.
- E. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 01 73 00 "Execution."
  1. Obtain necessary permits and approvals from City and County of Denver.
  2. Provide waste chutes as required in accordance with applicable laws and regulations.
- F. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel. The selection of type, size and number of hoisting facilities is the solely the responsibility of the Contractor.
  1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.
- G. Temporary Elevator Use: Use of elevators is not permitted without prior written approval of the Architect/Engineer and University Project Manager.
  1. If so approved, only one designated elevator may be used subject to the requirements of "Existing Elevator Use" paragraph below.
- H. Existing Elevator Use: When approved by University, one designated existing elevator may be used at no charge to Contractor or other subcontractors for transporting personnel, small tools, materials, and equipment. Comply with requirements of Section 01 10 00 "Summary" and the following:
  1. Contractor will not be granted exclusive use of the designated elevator. University personnel and staff will be permitted to use this elevator as their work duties require.
  2. Entire car is lined (floor, walls, ceiling) with 3/4 inch Fir plywood or equivalent.
  3. Total load carried does not exceed rated capacity of elevator.

4. No materials, equipment, trash, tools or other items too large to be readily moved into and out of the car may be carried in the elevator.
  5. Before acceptance of the building, linings are removed; all exposed surfaces are in new condition; all controls, relays, other parts showing any wear have been replaced.
  6. Entire elevator, including machinery, electrical components, doors, operators and controls shall be tested, adjusted, and put in new condition with specified warranties and maintenance to take effect at date of Completion Certificate.
  7. Written clearance has been obtained from the Elevator Service Company stating that the installation is safe and complete for this use prior to using it.
  8. The Contractor signs the Elevator Service Company's standard agreement and release forms for this usage and pays charges for maintenance, service, repairs, and reconditioning.
- I. Existing Stair Usage: Use of University's existing stairs will be permitted, provided stairs are cleaned and maintained in a condition acceptable to University. At Substantial Completion, restore stairs to condition existing before initial use.
1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If stairs become damaged, restore damaged areas so no evidence remains of correction work.
- J. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

### 3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
- B. Protection of Work: Protect in-progress and completed work from damage or deterioration, other than normal weathering of exposed materials, through construction duration until completion, as appropriate and as recommended by manufacturer and Installer.
1. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings. Protect finished floors and stairs from traffic, movement of heavy objects, and storage.
  2. Prohibit traffic and storage on waterproofed and roofed surfaces, on lawn and landscaped areas.
  3. Always protect excavation, trenches, and building, from damage from rain water, spring water, ground water, backing up of drains or sewers. Provide pumps, equipment, enclosures, to provide this protection.
  4. Remove protective coverings and materials at the appropriate time but no later than final cleaning operations.
- C. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
1. Comply with work restrictions specified in Section 01 10 00 "Summary."
- D. Security: Provide security program and facilities to protect the Work, existing facilities, and University operations and to prevent unauthorized entrance, vandalism, theft, and similar violations of security.
1. Coordinate with University Police.
  2. Provide lockable entrances and lock entrances at end of each work day.



3. After review and approval by University, install temporary enclosure around partially completed areas of construction.
  4. Storage: Where materials and equipment must be stored, and are of value or attractive for theft, provide a secure lockup. Enforce discipline in connection with the installation and release of material to minimize the opportunity for theft and vandalism.
- E. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting wherever required to prevent accidents and losses.
- F. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.
- G. Temporary Partitions: Provide floor-to-floor or floor-to-ceiling dustproof partitions terminating in dustproof floor or ceiling above to limit dust and dirt migration and to separate existing active elevator hoistways and other areas occupied by University from dust, fumes and noise in compliance with Section 01 35 46 "Indoor Air Quality" and the following:
1. Construct dustproof partitions with 5/8 inch gypsum wallboard with joints taped on occupied side, and 1/2 inch fire-retardant-treated plywood on construction operations side.
  2. Where fire-resistance-rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.
  3. Insulate partitions to control noise transmission to occupied areas.
  4. Seal joints and perimeter. Equip partitions with gasketed dustproof doors and security locks where openings are required.
  5. Protect air-handling equipment.
  6. Provide walk-off mats at each entrance through temporary partition.
  7. At elevator hoistway entrances not used during construction, seal openings with plastic sheet and duct tape.
- H. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.
1. Fire Extinguishers: Minimum one per floor at or near useable exit.
    - a. Provide additional extinguishers where convenient and effective for intended purpose.
    - b. Comply with NFPA 10 to the extent applicable.
  2. Strictly enforce site prohibition against smoking.
  3. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
  4. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Coordinate with University Project Manager to review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
  5. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.
  6. Maintain unobstructed access to fire extinguishers, temporary fire protection facilities, stairways and other access routes for fighting fires.
  7. Store combustible materials in containers in fire-safe locations.
  8. Permanent Fire Protection System: Complete and make operational at earliest possible date. Instruct site personnel on use of permanent system.

3.5 MOISTURE AND MOLD CONTROL

- A. Contractor's Moisture-Protection Plan: Comply with requirements in Section 01 35 46 "Indoor Air Quality Procedures."

3.6 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
  - 1. Do not permit temporary offices and similar temporary or permanent spaces to be used as living quarters or for other unintended occupancies or uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
  - 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Janitorial Services: Provide daily janitorial services for temporary offices, toilets, and similar areas at the project site. Require users of other temporary facilities to maintain clean and orderly premises.
- D. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- E. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion, unless Architect/Engineer requests that it be retained for a longer period of time. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
  - 1. Materials and facilities that constitute temporary facilities are property of Contractor. University reserves right to take possession of Project identification signs.
  - 2. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 01 77 00 "Closeout Procedures."

**END OF SECTION 01 50 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, storing, 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.
  5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
  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.
  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:
  - 1. Construction layout.
  - 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.
  - 9. Correction of the Work.
- 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 reasonably 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.
  - 4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces.
- 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.
  1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
  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.
  - 9. Chemicals.

10. Light.
11. Radiation.
12. Puncture.
13. Abrasion.
14. Heavy traffic.
15. Soiling, staining and corrosion.
16. Bacteria.
17. Rodent and insect infestation.
18. Combustion.
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.
26. Unprotected storage.
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 32 33 "Photographic Documentation" for submitting final completion construction photographic documentation.
  - 2. Section 01 73 00 "Execution" for progress cleaning of Project site.
  - 3. Section 01 78 23 "Operation and Maintenance Data" for operation and maintenance manual requirements.
  - 4. Section 01 78 39 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
  - 5. 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.
  - 3. Certificate of Occupancy: Submit Certificate of Occupancy (CO) or Temporary Certificate of Occupancy (TCO).
  - 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 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.
    - 1) Clean HVAC system in compliance with NADCA Standard 1992-01. Provide written report on completion of cleaning.
  - 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 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**

## **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.

## Supplemental Notice of Occupancy and Use List - Building / Project Acceptance List

Project Name & Number: \_\_\_\_\_

Contractor: \_\_\_\_\_

In addition to completing Notice of Approval of Occupancy / Use (SBP-01), the following items must be completed before Occupancy is approved.

Activity	Date Completed	Remarks
1. Review State Buildings Pre-Acceptance check list & Notice of Approval of Occupancy / use form with BMO rep & confirm agreement with status		
2. Training for BMO and FSS on installed equipment and systems is completed.		
3. Final and formal address posted on the building entries. Signage in place including monument sign, site signage, exterior and interior signage		
4. Roof walking pads to access equipment are installed.		
5. Plan to include first floor main isolation locations and plans for each floor to include main utility shutoffs, for include water, electrical, steam, sewer, fuel supply, telecom, fiber optic and gasses.		
6. All Contractor provided equipment has new filters & construction filters removed. Attic stock is inventoried, located in secured location, and matches spec. requirements.		
7. Maintenance & operations manuals and spare parts provided to BMO Representative and BMO Archivist; Including at least: fixtures, mechanical, electrical, plumbing, hardware for doors & locks, roll up doors, Spare fire suppression heads, tool & spare fuses		
8. Testing Certifications provided to BMO for Fire Systems & Annunciator Systems. Cabinet in main electrical room includes one complete set for major equipment. Alarms at Anschutz Medical Campus report to University Police Dispatch and at Downtown report to designated monitoring company.		
9. Equipment keys and locks transitioned to Operations, including fire panels, electrical panels, directories and generator panels. Construction cores removed and replaced with permanent cores.		
10. Access control pathways and junction boxes for installed doors, gates, loading docks and roof access complete. <b><u>*All wiring and hardware completed and electronic security access controls in place and tested by University Electronic Security.</u></b>		
11. BAS System (Siemens), Energy and Lighting, Fuel Systems, and Power Management must report remotely. Verify with University Engineering. 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.		
12. Notice of Partial Substantial Completion concerning roles/ responsibilities of University and Contractor for security, maintenance, heat, utilities has been reviewed and accepted. Establish list of post construction change orders & track separately from basic project until items are complete – call it Phase 2 to avoid delay on basic project.		

13. Warranty Dates and Contact list for all Contractors and Suppliers given to BMO.		
14. EH&S is provided, as applicable: fume hood certification, water testing certification, hazardous waste compliance certification, radiation compliance certification, BSL3 certification, and all other specialty equipment certification.		
15. All required Regulatory reports, have been provided to BMO, including: Air Emissions; Sewer, including for process diverters, traps, collection tanks, Fuel Storage Tanks and Detection, and Water System tests.		
16. A copy of the Contractor's red line "as-builts" and signed stamped drawings for Fire Detection and Suppression has been given to AE, BMO rep and placed in the Projects plan room. AE will prepare Record Documents. A hard copy of Record Documents will replace the redlines once available in the plan room. Hard copy or electronic copy will be provided to BMO. Electronic copies only will be provided to the Archive Officer. .		
17. Electrical system one line diagram framed and mounted in electrical room.		
<b>18. <u>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.</u></b>		
19. Interior Finishes Binder given to the University Project Manager and an electronic copy given to the Archive Officer.		
20. If Commissioning Report is completed, BMO has reviewed/ commented, including electrical, plumbing, mechanical/ HVAC.		
21. Testing Certifications provided to BMO for Elevators. Elevator tools, including hand tools, computer, proprietary and operational software is received and confirm 1-year service from date of acceptance. Elevator equipment rooms insulated and space conditioned for control system requirements.		
22. FSS has been provided with copy of Building Department testing and inspection report for window washing equipment.		
23. PM notifies University Risk Management that project is transferring to University and notifies Contractor that it can eliminate Builders Risk Insurance. PM to communicate to fire department via Life Safety Officer that building has transitioned to BMO.		
24. Trash receptacles outside the building are in place. If exterior work is applicable: Landscape – Include a walk through with University Grounds for 1) new & established 1-year service date; 2) existing damaged landscape is repaired; and 3) irrigation – zone control test is complete.		
25. Other: TAB Reports for Water and Air.		

\_\_\_\_\_  
University Project Manager  
(sign & print name)

\_\_\_\_\_  
Date

\_\_\_\_\_  
University BMO Rep.  
(sign & print name)

\_\_\_\_\_  
Date

\_\_\_\_\_  
University FSS Rep  
(sign & print name)

\_\_\_\_\_  
Date

**\*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

- 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.
    3. Manual 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, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
  - 1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size and enable OCR (optical character recognition) to provide searchable text.
  - 2. File Names and Bookmarks: Enable bookmarking of individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.
- I. 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.
  - 4. Supplementary Text: Prepared on 8-1/2-by-11-inch, 20 lb., white bond paper.
  - 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.
9. Automatic entrances.
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:

- a. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
- 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.
  5. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.
- 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.
  - a. Include procedures to follow and required notifications for warranty claims.
  - b. Include information sheet covering proper procedures in event of failure and instances which might affect validity of warranties and 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.
  2. Cross-reference Specification Section number and title.
  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.
  4. Material and chemical composition.
  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.
  - 3. Gas leak.
  - 4. Water leak.
  - 5. Power failure.
  - 6. Water outage.
  - 7. System, subsystem, or equipment failure.
  - 8. Chemical release or spill.
- C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of University's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- D. Emergency Procedures: Include the following, as applicable:
  - 1. Instructions on stopping.
  - 2. Shutdown instructions for each type of emergency.
  - 3. Operating instructions for conditions outside normal operating limits.
  - 4. Required sequences for electric or electronic systems.
  - 5. Special operating instructions and procedures.

## 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.

**END OF SECTION 01 78 39**

## **SECTION 01 79 00 - DEMONSTRATION AND TRAINING**

### **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 instructing University's personnel, including the following:
  - 1. Demonstration of operation of systems, subsystems, and equipment.
  - 2. Training in operation and maintenance of systems, subsystems, and equipment.

#### **1.3 INFORMATIONAL SUBMITTALS**

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include outline for each training module.
- B. Qualification Data: For instructor, demonstrating qualifications and ability to instruct on maintenance and care of system, equipment and products.
- C. Schedule of Demonstration and Training: Prepare a schedule in tabular form of all demonstration and training required in individual Specification Sections including:
  - 1. Specification Section number and title.
  - 2. Description of required demonstration and training.
- D. Attendance Record: For each training module, submit list of participants and length of instruction time.

#### **1.4 QUALITY ASSURANCE**

- A. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 01 40 00 "Quality Requirements," experienced in operation and maintenance procedures and training. Manufacturer's sales staff is not acceptable.
- B. Pre-instruction 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 demonstration and training.



## PART 2 - PRODUCTS

### 2.1 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: For each module, include instruction for the following as applicable to the system, equipment, or component:
  - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
    - a. System, subsystem, and equipment descriptions.
    - b. Performance and design criteria if Contractor is delegated design responsibility.
    - c. Operating standards.
    - d. Regulatory requirements.
    - e. Equipment function.
    - f. Operating characteristics.
    - g. Limiting conditions.
    - h. Performance curves.
  - 2. Documentation: Review the following items in detail:
    - a. Emergency manuals.
    - b. Operations manuals.
    - c. Maintenance manuals.
    - d. Project record documents.
    - e. Identification systems.
    - f. Warranties and bonds.
    - g. Maintenance service agreements and similar continuing commitments.
  - 3. Emergencies: Include the following, as applicable:
    - a. Instructions on meaning of warnings, trouble indications, and error messages.
    - b. Instructions on stopping.
    - c. Shutdown instructions for each type of emergency.
    - d. Operating instructions for conditions outside of normal operating limits.
    - e. Sequences for electric or electronic systems.
    - f. Special operating instructions and procedures.
    - g. A tour of the installation identifying the location of all system components.
  - 4. Operations: 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. Control sequences.
    - f. Safety procedures.
    - g. Instructions on stopping.
    - h. Normal shutdown instructions.
    - i. Operating procedures for emergencies.
    - j. Operating procedures for system, subsystem, or equipment failure.
    - k. Seasonal and weekend operating instructions.

- l. Required sequences for electric or electronic systems.
  - m. Special operating instructions and procedures.
  - n. Sequence of operation.
5. Adjustments: Include the following:
  - a. Alignments.
  - b. Checking adjustments.
  - c. Noise and vibration adjustments.
  - d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
  - a. Diagnostic instructions.
  - b. Test and inspection procedures.
7. Maintenance: Include the following:
  - a. Inspection procedures.
  - b. Types of cleaning agents to be used and methods of cleaning.
  - c. List of cleaning agents and methods of cleaning detrimental to product.
  - d. Procedures for routine cleaning
  - e. Procedures for preventive maintenance.
  - f. Procedures for routine maintenance.
  - g. Instruction on use of special tools.
8. Repairs: Include the following:
  - a. Diagnosis instructions.
  - b. Repair instructions.
  - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
  - d. Instructions for identifying parts and components.
  - e. Review of spare parts needed for operation and maintenance.
  - f. Product support/service model.
  - g. Purchasing of replacement parts.
9. Instruction specific to Instrumentation and Controls, Electrical Gateway, Network Lighting Controls, or any other new technology that is integrated with another system: Include the following:
  - a. Overview and theory.
  - b. Wiring diagrams, including the one line diagram.
  - c. Creation, editing, and programming of the point database.
  - d. Integration topology and platform for communication.
  - e. Graphics packages and touch screens for the system.
  - f. Alarms and diagnostics.
  - g. Reporting functions dynamically and historically.
  - h. Remote access to the system.
  - i. Database back-up and maintenance.
  - j. Replacement and re-programming of replacement parts.
  - k. Point type and functionality for each type of point.
  - l. Programming.
  - m. Point/object editing.
  - n. Loop tuning.
  - o. Help files and other troubleshooting documentation.

- p. Instruction is given by the staff that setup the integration.
- C. Operation and Maintenance Manuals: Provide appropriate Operation and Maintenance manuals in each training session so that the detail drawings and maintenance activities are outlined and discussed for each application.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module.
- B. Set up instructional equipment at instruction location.

### 3.2 INSTRUCTION

- A. Engage qualified instructors to instruct University's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
  - 1. University will furnish Contractor with names and positions of participants.
- B. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
  - 1. Coordinate schedule for all training with University Project Manager and provide the following:
    - a. Minimum 3 weeks notification.
    - b. Training matrix in calendar format.
    - c. Training outline for each session.
  - 2. Do not schedule training until equipment has been started up, commissioned, and is currently operating in its normal condition.
  - 3. Do not schedule overlapping training sessions.
  - 4. Schedule training sessions for a maximum of 4 hours per day; afternoons preferred.
  - 5. Provide separate training session on each system for operational/maintenance groups and user groups.
  - 6. Training sessions will be cancelled and rescheduled unless the following documentation is received:
    - a. Instruction qualifications.
    - b. Evidence that equipment has been started up, commissioned, and is currently operating in its normal condition.
    - c. Operation and Maintenance manuals.
- C. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- D. Travel, Room and Board: Coordinate any out-of-state training with the University Project Manager.
- E. Cleanup: Collect used and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

### 3.3 DEMONSTRATION SCHEDULE

SECTION	TITLE	DESCRIPTION
11 14 00	FOOD SERVICE EQUIPMENT	Engage a factory-authorized service representative to train University's maintenance personnel to adjust, operate, and maintain foodservice equipment.
23 00 00	HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)	Schedule instructional meetings for The University of Colorado Anschutz Medical Campus 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 testing.
23 05 13	MOTORS	Engage a factory-authorized representative to train the University's representative for 2 hours for each variable frequency drive installed. Training includes startup, shutdown, emergency operation, maintenance and servicing.
23 09 00	INSTRUMENTATION AND CONTROLS	Engage a factory-authorized trained representative to conduct a minimum of 1-four hour on-site training course and an additional 1-four hour on-site training course per 25,000 sq. ft. for designated University personnel.
26 00 00	ELECTRICAL	Engage a factory-authorized service representative to train the University's Operations personnel a minimum of 8 hours for each system. Provide an additional minimum of 4 hours for any electrical gateway or networked lighting controls.
26 56 00	EXTERIOR LIGHTING	Engage a factory-authorized service representative to train University's maintenance personnel to adjust, operate, and maintain luminaire lowering devices.
28 31 00	FIRE DETECTION AND ALARM	Engage a factory-authorized service representative to train the University's Operations personnel a minimum of 8 hours for each system.

**END OF SECTION 01 79 00**

## **SECTION 02 81 00 - TRANSPORTATION/DISPOSAL OF HAZARDOUS MATERIAL**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. This section provides standards discovery, abatement, disposal, and worker protection for all hazardous materials including asbestos, lead, polychlorinated biphenyls (PCBs), mercury, radioactive materials, and mold.
- B. All hazardous materials and waste must be managed and coordinated with Environmental Health and Safety (EHS) through the University Project Manager.

#### **1.2 REFERENCES**

- A. Occupational Safety and Health Administration, 29 CFR 1926.1101, Asbestos.
- B. Occupational Safety and Health Administration, 29 CFR 1926.62, Lead Standard.
- C. Environmental Protection Agency, 40 CFR 763.120, Asbestos Worker Protection Rule.
- D. Environmental Protection Agency, 40 CFR 61, National Emissions Standards for Hazardous Air Pollutants.
- E. Environmental Protection Agency 40 CFR 261.24, Toxicity Characteristic
- F. Environmental Protection Agency, 40 CFR 262, Standards Applicable to Generators of Hazardous Waste
- G. Environmental Protection Agency, 40 CFR 265, Interim Status Standards for Owners and Operators of Hazardous Waste Treatment Storage and Disposal Facilities.
- H. Code of Colorado Regulation Number 8 Control of Hazardous Air Pollutants, Part B Asbestos Control, 5 CCR 1001 – 10 Part B.
- I. Colorado Department of Public Health and Environment (CDPHE) Regulations Pertaining to Solid Waste Sites and Facilities, Section 5.5. Management of Asbestos-Contaminated Soil, 6 CCR 1007-2.
- J. Air Quality Control Commission (AQCC) Regulations 19 – Lead-Based Paint Abatement.
- K. Asbestos-Contaminated Soil Management, Standard Operating Procedure Document, Version 1, February 26, 2010.

#### **1.3 SYSTEM PERFORMANCE REQUIREMENTS**

- A. Performance Requirements - Asbestos
  - 1. Presence on Campus:
    - a. Asbestos is present in many building in and around the campus. Typical forms of asbestos containing materials (ACM) include pipe insulation, ceiling, wall, floor and roof materials.
    - b. Investigate every project where work will occur prior to soil disturbing activities to identify asbestos containing materials (ACM). The University Project Manager is responsible for coordinating and ensuring that an inspection or review of previous surveys and any required sampling be performed prior to finalizing the scope or work and associated budget.

- c. Include the cost of investigations, sampling, waste transportation, disposal and associated costs in the cost of the project.
  - 2. Excavation Notifications: Required as described below prior to beginning soil disturbing activities.
    - a. Localized Limited Quantity Shallow Hand Digging – No notification required.
    - b. Small Scale Localized Hand/Equipment Excavation – No notification required.
    - c. Moderate Scale Localized Equipment Excavation – Notification to the University.
    - d. Large Scale Equipment Excavation – Notification to the University.
  - 3. Discovery of Asbestos:
    - a. Notify contractors and the University Project Manager via project documents to stop work when asbestos is encountered or thought to be encountered. It is the responsibility of the University Project Manager to decide what type of action will follow, in consultation with the University's EHS Department.
  - 4. Asbestos Removal:
    - a. Perform any asbestos removal (abatement), repair, encapsulation or spill clean-up in accordance with the above referenced regulatory standards.
    - b. Utilize qualified and trained personnel for abatement design and removal in accordance with the above referenced regulatory standards.
  - 5. Asbestos Containing Waste
    - a. Follow the University asbestos waste disposal guidelines and Environmental Protection Agency regulations for disposal of asbestos generated at each project.
- B. Performance Requirements – Lead
  - 1. Presence on Campus:
    - a. Typical forms of lead containing materials (LCM) include paint, lead shielding materials, electronic equipment, and piping (sink traps).
    - b. Consult with EHS through the University Project Manager to determine when LCM investigation is required. The University Project Manager is responsible for coordinating and ensuring that an inspection or review of previous surveys and any required sampling be performed prior to finalizing the scope or work and associated budget.
    - c. Include the cost of investigations, sampling, waste transportation, disposal and associated costs in the cost of the project.
  - 2. Discovery of Lead:
    - a. Suspect LCM at all painted surfaces of older campus buildings, brick, and walls and floors in rooms designated (or previously designated) for radiography.
    - b. Notify contractors and the University Project Manager via project documents when lead is encountered or thought to be encountered. It is the responsibility of the University Project Manager to consult with EHS to decide what type of action will follow.
  - 3. Lead Renovation:
    - a. Perform any renovation of lead containing materials, repair, encapsulation or clean-up in accordance with the above referenced regulatory standards.
    - b. Utilize qualified and trained personnel for renovation in accordance with the above referenced regulatory standards.
  - 4. Handling of Lead Waste:
    - a. Coordinate with EHS through the University Project Manager.
    - b. Include all costs associated with handling of lead waste in the Project Cost.

#### 1.4 SUBMITTALS

- A. Abatement Specifications:
  - 1. Provide a certified asbestos project manager on all asbestos abatement projects in which the amount of friable asbestos material to be abated exceeds 1000 linear feet on pipes or 3000 square feet on other surfaces.
  - 2. The certified asbestos project manager must prepare and approve written abatement specifications.
  - 3. Coordinate with the University EHS Department for additional requirements per project.

B. Asbestos Waste Manifests:

1. Prepare hazardous waste manifests for all asbestos waste shipments associated with University asbestos related projects. Submit copies and originals of these manifests in sequential (numerical) order to the University.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

PART 4 - ILLUSTRATIONS

A. Asbestos-Contaminated Soil Management, Standard Operating Procedure Document, Version 1, February 26, 2010.

1. Coordinate with the University Project Manager for attachments.

# ASBESTOS-CONTAMINATED SOIL MANAGEMENT

## STANDARD OPERATING PROCEDURE DOCUMENT

### UNIVERSITY OF COLORADO DENVER ANSCHUTZ MEDICAL CAMPUS

*Prepared for*



University of Colorado Denver



February 26, 2010



**WALSH ENVIRONMENTAL SCIENTISTS AND ENGINEERS, LLC**

4888 Pearl East Circle, Suite 108

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(303) 443-3282

Project Number: 4299-630



# **UNIVERSITY OF COLORADO DENVER ANSCHUTZ MEDICAL CAMPUS (AMC) ASBESTOS-CONTAMINATED SOIL MANAGEMENT STANDARD OPERATING PROCEDURE DOCUMENT**

February 26, 2010

Prepared for: University of Colorado Denver  
Anschutz Medical Campus

Prepared by:

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Tom Butts  
State of Colorado Certified Project Designer

*Submitted by*  
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WALSH Project Number: 4299-630

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**University of Colorado  
Anschutz Medical Campus  
Asbestos-Contaminated Soil Management  
Standard Operating Procedure Document**

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**Attachments**

Attachment #1	ACS Classification and AMC Boundary Site Drawing (and Survey Drawings)
Attachment #2	Historical Buildings and Steam Tunnels Site Drawing
Attachment #3	SOP Flow Chart
Attachment #4	Soil Sampling and Analysis Plan (SAP)
Attachment #5	Remediation Plan
Attachment #6	CDPHE Notification Summary and Notification Forms

## 1 Purpose

This Standard Operating Procedure (SOP) document provides written standard operating procedures that are the minimum requirements for the proper training, handling, packaging, and disposal of asbestos-contaminated soil (ACS) during soil disturbing activities at the Anschutz Medical Campus (AMC) of the University of Colorado Denver (UCD). This SOP document provides specific procedures for the “**management**” of asbestos contaminated soil to remove only that asbestos contaminated soil, necessary to perform the work. Where “**remediation**” is intended to remove the full extent and depth of asbestos contaminated soil for a specific area, refer to the attached *Soil Sampling and Analysis* procedures provided as a supplement to this SOP in Attachment #4 and *Remediation* procedures provided as a supplement to this SOP in Attachment #5 of this document. The SOP was prepared for CDPHE review and approval to allow AMC to use this SOP for management of the discovered ACS rather than preparing a site specific soil characterization and management plan (SCMP) each time ACS is discovered at ACM. This document is intended for use by those directly involved with soil disturbing activities on the campus, and those who provide management/supervision of these soil disturbing activities.

UCD AMC is part of the University of Colorado and is a 227-acre campus devoted to biomedical education, patient care, and drug development is located in Aurora, Colorado on the site of the former Fitzsimons Army Medical Center. The campus is located on the north side of Colfax Avenue, between Peoria Street and Fitzsimons Parkway.

## 2 Scope

The procedures provided in this document shall apply to all personnel and all activities involved with the disturbance of soil known to contain asbestos material or soil that may reasonably be considered to contain asbestos material.

## 3 Primary Contacts, Roles and Responsibilities

<b>Organization</b>	<b>Role/Responsibility</b>	<b>Contact Information</b>
UCD – Facilities Management	Project Management	Ken Neeper, Manager Infrastructure Development, Phone: 303.724.0249 Email: <a href="mailto:Ken.Neeper@UCDenver.edu">Ken.Neeper@UCDenver.edu</a>
UCD – Environmental Health and Safety Division	Environmental Compliance – Health and Safety	Christina Aguilera Phone: 303.724.0242 Email: <a href="mailto:Christina.Aguilera@ucdenver.edu">Christina.Aguilera@ucdenver.edu</a>
CDPHE HMWMD	Regulatory Agency	Jeff Swanson – Remediation and Restoration Unit – Federal Facilities Program Phone: 303.692.3416 <a href="mailto:jrswanso@cdphe.state.co.us">jrswanso@cdphe.state.co.us</a>
Non-ACS Excavation Contractor	As needed excavation of non-ACS soil in accordance with this plan	To be determined as needed
ACS Excavation Contractor	As needed removal of ACS in accordance with this SOP	To be determined as needed
ACS Consultant	As needed ACS Consulting (soil characterization, remediation oversight, soil spotting, air monitoring)	To be determined as needed

## 4 Definitions and Abbreviations

### 4.1 Abbreviations

ACM                      Asbestos-containing materials

ACS	Asbestos-contaminated soil
AMC	Anschutz Medical Campus
AMS	Asbestos Air Monitoring Specialist, CDPHE Certified
CDPHE	Colorado Department of Public Health and Environment
GIS	Geographic information system
GPS	Geographic positioning system
MPH	Miles per hour
NESHAP	National Emissions Standards for Hazardous Air Pollutants
NIOSH	National Institute of Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
PCM	Phase Contrast Microscope
PLM	Polarized Light Microscopy
PPE	Personal Protective Equipment
SOP	Standard Operating Procedure

## 4.2 Definitions

**“Air Monitoring Specialist”** means a person who performs air monitoring referred to in this guidance and who is certified to perform air monitoring in accordance with Air Regulation No. 8, Part B.

**Asbestos Soil Inspector** means a person certified in accordance with Air Regulation No. 8, Part B, to perform asbestos inspection and sampling, and who has a minimum of six (6) months experience in asbestos-contaminated soil inspections.

**“Asbestos Supervisor”** means a person who has been certified as an asbestos Supervisor in accordance with Air Regulation No. 8, Part B.

**“Asbestos Project Designer”** or **“Project Designer”** means a person who has been certified as an asbestos Project Designer in accordance with Air Regulation No. 8, Part B.

**“Adequately wet”** means sufficiently mix or penetrate with liquid to completely prevent the release of particulate material and fibers into the ambient air. If visible emissions are observed coming from asbestos-contaminated soil or asbestos-containing material, then the material has not been adequately wetted. However, the absence of visible emissions is not sufficient evidence of being adequately wet. Guidance on determining when a material is adequately wet can be found in EPA’s *Asbestos NESHAP Adequately Wet Guidance*, EPA 340/1-90-019 (December 1990).

**“Asbestos”** means the asbestiform varieties of serpentinite (chrysotile), riebeckite (crocidolite), amosite (cummingtonite-grunerite), anthophyllite, and actinolite-tremolite.

**“Asbestos-contaminated soil”** means soil containing any amount of asbestos.

**“Asbestos waste”** means any asbestos-containing material whether it contains friable or nonfriable asbestos, that is not intended for further use. This term includes but is not limited to asbestos mill tailings, asbestos from pollution control devices, and containers that contain asbestos.

**“Asbestos-containing material”** means any material that contains more than one percent (1%) asbestos by weight, area or volume.

**“Consultant”** refers to entity contracted to perform training, inspections, and air monitoring related to soil disturbing activities in accordance with the SOP.

**“Contractor”** refers to entity contracted to perform soil disturbing activities in accordance with the SOP.

**“Facility Component”** means any component associated with a structure, installation, or building and includes buried utilities, tanks, structures or other installations.

**“Friable”** means that the material, when dry, may be crumbled, pulverized, or reduced to powder by hand pressure, and includes previously nonfriable material after such previously nonfriable material becomes damaged to the extent that when dry it may be crumbled, pulverized, or reduced to powder by hand pressure.

**“Leak tight”** means that solids, liquids, or gases cannot escape or spill out. It also means dust tight.

**“Mechanical”** means operated or produced by mechanism or machine. This may include, but shall not be limited to, an excavator, backhoe, grader, tiller, auger, or hand shovel.

**“Nonfriable”** means material which, when dry, may not be crumbled, pulverized, or reduced to powder by hand pressure.

**“Remediation”** or **“Remediate”** means a cleanup or removal to prevent or minimize the possible current or future release of hazardous substances to prevent an unacceptable threat to present or future public health, welfare or the environment.

**“Site”** or **“solid waste disposal site”** means the location for a facility chosen based upon geologic, hydrogeologic and operational considerations. For the purpose of Section 5.5 of the Solid Waste Regulations “site” means the area or areas where soil-disturbing activities are occurring or will occur.

**“Soil-disturbing activities”** means excavation, grading, tilling, or any other mechanical activity used to disturb the soil.

**“Visible emissions”** means any emissions which are visually detectable without the aid of instruments, coming from material containing asbestos, asbestos waste, asbestos-contaminated soil, or from handling and disposal of asbestos waste, material containing asbestos or asbestos-contaminated soil.

**“Work Area”** means the area where soil disturbing activities are occurring. For asbestos contaminated soil disturbance, Work Area also means the regulated/controlled area boundary.

## 5 Disclosure due to Potential to Encounter ACS

The Anschutz Medical Campus (AMC) formerly the Fitzsimons Army Medical Center contained numerous buildings, some of which had been demolished and buried by the Army prior to property transfer to UCD. During development of the site by UCD, buried asbestos-containing materials located on building components (primarily direct buried steam lines, etc) and areas of asbestos-contaminated soil (asbestos debris in soil from prior building demolition, etc) have been discovered on the site. Based on excavation activities to date, these occurrences can be characterized as localized. Based on historical findings, the potential to encounter ACS on the AMC campus fall into one of the three following categories:

1. **Known ACS Area** - An area that is classified as having known ACS is one that has confirmed asbestos-containing material in the soil identified either from subsurface intrusive investigation, or from visual observation on the surface, in sidewalls, embankments, etc. This excavation is conducted by properly trained personnel in accordance with the provisions of this SOP.
2. **Moderate to High Potential ACS Area**– An area that is classified as having a **moderate potential** for encountering ACS is one based on historical review that asbestos material may be encountered in the soil *where non-suspect construction debris has been observed historically, including wood, concrete, brick and metal components*. An area that is classified as having a **high potential** for encountering ACS is one based on historical review that *suspect asbestos material is likely to be encountered in the soil where suspect asbestos construction debris has been observed historically*. Areas of Moderate to High Potential for encountering ACS may necessitate additional characterization using surface and subsurface visual inspection methods. For areas of Moderate to High Potential ACS, soil excavation activities shall be observed by an asbestos building inspector with 6 months asbestos in soil experience (asbestos soil inspector). For areas of Moderate to High Potential ACS “On-the-job” ACS awareness training shall be provided to workers directly involved with soil-disturbing activities.
3. **Low Potential ACS Area**– An area that is classified as having a low potential for encountering ACS is one in which historical review does not identify buildings or structures that previously existed at the site, utility corridors, other waste materials, or other indications that asbestos may exist on the site. A site classified as having a low potential for encountering ACS would not be a “reason to believe that visible asbestos may be encountered.” Sites with a low potential for encountering ACS would not necessitate additional characterization, spotting, “on-the-job” awareness training, or other special provisions. However, if construction debris or potential ACM is encountered during the course of soil disturbance, then the area would become a moderate to high potential ACS area and will be subject to awareness training, soil spotting and other provisions as described in this SOP.

Asbestos debris in soil at AMC can consist of friable asbestos debris (pipe insulation, etc), nonfriable asbestos debris (floor tile and cement asbestos sheet used on roofs, etc), or a combination of both. Asbestos debris may be limited to a few small pieces that are removed under limited quantity discovery” procedures, or may be in a more extensive “debris field” that will be removed under “significant discovery procedures” as described in Sections 11 and 12 of this SOP.

Upon the discovery of any suspected construction debris material, the contractor shall immediately stop excavation activities in that area, and notify the UCD project manager so the condition can be inspected to determine if asbestos contaminated soil is present. These determinations will be made by an asbestos soil inspector which is an EPA accredited and CDPHE certified asbestos building inspector with 6 months soil inspection experience. Where asbestos contaminated soil is identified, this material shall be removed by a qualified contractor with properly trained personnel, in accordance with applicable regulations and procedures described in this SOP.

## 6 Regulatory Summary and Regulatory References

### 6.1 CDPHE Hazardous Materials Waste Management Division (HMWMD) – *“Asbestos Contaminated Soils” not associated with the “Built Environment”*

To address asbestos in soil, the Colorado Department of Public Health and Environment’s Hazardous Materials and Waste Management Division (HMWMD) has established specific management requirements for asbestos-contaminated soil under Section 5.5 of the Regulations Pertaining to Solid Waste Disposal Sites and Facilities (6 CCR 1007-2). Disposal of ACM, and work done in asbestos-contaminated soil (ACS), must comply with this regulation. The requirements of Section 5.5 of the Solid Waste Regulations apply to the owner or operator of any property with asbestos-contaminated soil at which soil-disturbing activities are occurring or planned for any area containing asbestos-contaminated soil. The requirements of Section 5.5 are triggered when the owner or operator has reason to believe or suspect the presence of asbestos-contaminated soil at a site, (through confirmation by analysis of observed material that is suspected of containing asbestos), or has reason to believe or suspects that visible asbestos will be encountered. An owner or operator that has no reason to know of or suspect asbestos-contaminated soil at a site does not have a duty to sample or otherwise investigate for asbestos-contaminated soil prior to commencing excavation, or other soil disturbing activities, at the site. It is important to understand that there is no language in the Solid Waste Regulations that requires an owner or operator to perform soil-disturbing activities, or to remediate asbestos-contaminated soil. The regulations include specific requirements that apply if asbestos-contaminated soil is disturbed or will be disturbed.

To supplement the regulation, CDPHE developed a guidance document intended to provide direction to contractors, consultants and property owners who are involved in soil disturbing activities in areas with known or suspected asbestos-contaminated soil, or where asbestos-contaminated soil is discovered. The guidance is meant to assist in compliance with the Solid Waste Regulations, and where applicable, Air Quality Control Commission Regulation No. 8, Part B (5 CCR 1001-10, Part B - Asbestos).

CDPHE Solid Waste Regulations identify two methods for addressing ACS, **Management** and **Remediation**.

1. **Management** is the removal of only that asbestos-contaminated soil necessary to perform the work, without the intent to remove additional soil outside the scope, even where observed. Management of soil in place is included under this activity. Under management, post removal soil sampling is recommended but not required for soil management actions.
2. **Remediation** is the planned removal of all asbestos-contaminated soil, removing soil beyond a particular scope of work to remove visible and analytical documented presence of asbestos. Under remediation, clearance soil sampling is required.

Both Management and Remediation approaches require CDPHE approval of a site specific soils work plan or a standard operating procedures (SOP) plan.

Remediation would be the appropriate action where a “No Further Action” letter is sought from CDPHE, or where a consent order has been issued by CDPHE, or when “closure” documentation is desired, as Management is the more accepted cost effective option to address soil contamination where this “No Further Action” is not required.

Remediation of asbestos-contaminated soil is not required under the Solid Waste Regulations, but may be conducted in accordance with Section 5.5.5 of the Regulations. It should also be noted that sampling of asbestos-contaminated soil is not required under Section 5.5 of the Solid Waste Regulations; however, the information that can be gained from sampling may be beneficial for many projects. In addition, when conducting remediation required by CDPHE (consent order, etc), sampling may be necessary to demonstrate that cleanup objectives have been met. Remediation will only be conducted at AMC where it is the intent to remediate and/or receive a no further action letter.

In accordance with Section 5.5.2 of the Solid Waste Regulations, the following projects are exempt from the requirements of Section 5.5 of the Solid Waste Regulations, but may be subject to other sections of the Solid Waste Regulations or other regulatory programs:

1. In situations where the soil contains solely nonfriable material containing asbestos, that has not been rendered friable, the nonfriable material can be removed from the soil and properly disposed in accordance with Section 5.2 of the Solid Waste Regulations. The surrounding soil would not be considered to be asbestos-contaminated soil, and therefore would not be subject to the requirements of Section 5.5 of the Solid Waste Regulations. The determination that a material is nonfriable must be made by an asbestos Building Inspector who has been certified in accordance with AQCC Regulation No. 8, Part B, and who has a minimum of six (6) months experience in asbestos-contaminated soil inspections (see Section 8.3 Worker Training).
2. The requirements of Section 5.5 of the Solid Waste Regulations do not apply to asbestos abatement of facility components (including pipes, ducts and boilers) conducted in accordance with AQCC Regulation No. 8, Part B. However, disposal of asbestos must still comply with Sections 5.1 through 5.4 of the Solid Waste Regulations.
3. The requirements of Section 5.5 of the Solid Waste Regulations do not apply to spill response activities that are subject to the requirements of AQCC Regulation No. 8, Part B. As above, disposal of asbestos must still comply with Sections 5.1 through 5.4 of the Solid Waste Regulations.
4. Ambient occurrences of asbestos that are not due to site-specific activities. Ambient occurrences of asbestos may include, but are not limited to, naturally occurring asbestos or the distribution of asbestos from normal wear of automotive products.
5. Projects involving excavations with a total volume of less than 1 cubic yard of soil using low-emission excavation methods such as hand held tools or light equipment.

The exemption for asbestos abatement projects conducted under AQCC Regulation No. 8, Part B, includes asbestos debris that may come into contact with soil during demolition of structures with asbestos-containing materials and materials containing trace amounts of asbestos (including trace soil in crawlspaces, loose fill vermiculite, etc) that can legally remain during demolition and be disposed of as normal demolition debris. Any asbestos debris left behind after the completion of a demolition project and associated site cleanup, would be subject to the requirements of Section 5.5 of the Solid Waste Regulations if disturbed in the future.

## **6.2 EPA, OSHA DOT and CDPHE Air Pollution Control Division (APCD)** ***“Asbestos/Asbestos Contaminated Soils” associated with the “Built Environment”***

The Environmental Protection Agency (EPA), the Occupational Safety and Health Administration (OSHA) and the Colorado Department of Public Health and Environment (CDPHE) define *asbestos-containing material* (ACM) as any material containing greater than 1% asbestos as asbestos-containing material. EPA, OSHA and CDPHE define *friable* materials as those materials that can be crumbled or reduced to powder by hand pressure, whereas *nonfriable* materials cannot. Friable materials are more likely to be released into the air, especially during renovation and demolition of the building. Under EPA and CDPHE regulations, certain types of nonfriable materials (such as tar impregnated roofing and vinyl asbestos floor tile) may remain during normal demolition (provided these materials remain nonfriable during the demolition process) and also may be disposed of as normal demolition debris. In addition drywall joint compound that contains greater than 1% asbestos may remain in a building for demolition and disposal as normal demolition debris provided the joint compound was not used as a surfacing material and the composite result of the drywall and joint compound reported less than 1% asbestos. Additionally, materials containing trace to 1% are not subject to EPA and CDPHE regulations and may remain in a building during



demolition and may be disposed of as normal demolition debris. Under these provisions, it is common for asbestos to remain in a building for demolition and for subsequent disposal as normal demolition debris.

ACM is subject to the EPA National Emissions Standards for Hazardous Air Pollutants (NESHAPs) Regulations for Asbestos (40 CFR Part 61) which includes specific provisions for renovation and demolition projects pertaining to the “built” environment, and disposal of asbestos-containing waste material. ACM is subject to the EPA Toxic Substances Control Act (TSCA) which includes provisions for training and certification for asbestos remediation and consulting activities. The CDPHE is presently responsible for administering the EPA NESHAP and TSCA program for Colorado.

ACM is subject to OSHA Construction Industry Standard for Asbestos (29 CFR Parts 1910.1101). Materials containing 1% or less asbestos may be subject to OSHA regulations under certain classes of work activity, or if air concentrations are at or above the personal exposure limit (PEL) of 0.1 f/cc or the excursion limit of 1.0 f/cc. The OSHA asbestos standard includes provision for hazard communication, training, exposure assessment, respiratory protection, engineering controls, medical evaluations, and other provisions.

ACM is subject to Department of Transportation (DOT) regulations for packaging, labeling and transportation of asbestos under 49 CFR Part 173.

ACM is subject to applicable requirements of the CDPHE Air Pollution Control Division’s (APCD) Regulation 8. The term **Abatement** is defined by the CDPHE under the Air Pollution Control Division Regulation 8, and includes the removal of asbestos-containing materials covering facility components, which includes discovery wrapped steam line found below grade, transite<sup>®</sup> water pipe, or an abandoned buried boiler covered with asbestos. Removal of asbestos in soil associated with facility components would be subject to the requirements under CDPHE Air Pollution Regulation 8, including contractor licensing, worker certifications, permitting, etc.

1. Removal of asbestos-containing material on a facility component, that is located on or in soil that will be disturbed, shall be conducted (as stipulated under Section 5.5 of the Solid Waste Regulations), in accordance with work practices in AQCC Regulation No. 8, Part B, Section III.O, but is not subject to the permit requirements of AQCC Regulation No. 8, Part B, as long as the total quantity of asbestos-containing material is below the following trigger levels:
  - a) 260 linear feet on pipes,
  - b) 160 square feet on other surfaces, or
  - c) The volume equivalent of a 55-gallon drum.
2. Removal of asbestos-containing material on a facility component with asbestos quantities above the trigger levels is subject to the notification, permit, and abatement requirements of AQCC Regulation No. 8, Part B, and is therefore outside the scope of Section 5.5 of the Solid Waste Regulations, as provided in Section 5.5.2(B) of the regulations.
3. Removal of pieces of asbestos-containing material, that are not on a facility component, and are located on or in soil that will be disturbed, shall be conducted under Section 5.5 of the Solid Waste Regulations, in accordance with work practices in AQCC Regulation No. 8 - Part B, Section III.O. The removal activities would not be subject to the permit requirements of AQCC Regulation No. 8, Part B.

Under EPA NESHAPs/CDPHE APCD regulations, the primary consideration under this SOP is adherence to CDPHE APCD Regulation 8 requirements for the discovery of asbestos-containing materials on buried facility components such as piping, boilers, etc and the proper removal in accordance with the EPA NESHAPs and CDPHE APCD regulations. Under CDPHE APCD regulations, secondary consideration under this SOP is the proper removal of all construction debris including nonfriable materials allowed to remain during demolition, asbestos-containing joint compound (where composite result reported less than 1%) and trace-1% asbestos materials. Where demolition debris is allowed to remain after demolition activities have been completed, any presence of asbestos in the soil would then be subject to the CDPHE HMWD ACS regulations. This issue is addressed in more detail in Section 13 (Special Considerations) of this SOP.

All work on asbestos-containing materials (ACM) must comply with the applicable requirements of EPA, OSHA, DOT and CDPHE APCD asbestos regulations.

### 6.3 References

- CDPHE. 2006. *Asbestos-Contaminated Soil Guidance Document*. Prepared in draft form April 2006 by the Hazardous Materials and Waste Management Division.
- CDPHE. 2006. *Asbestos-Contaminated Soil Regulations*. Section 5.5 of the Hazardous Materials and Waste Management Division's Regulations Pertaining to Solid Waste Disposal Sites and Facilities
- CDPHE. 2008, Air Quality Control Commission Regulation No. 8, Part B (5 CCR 1001-10, Part B - Asbestos).
- OSHA. *Construction Industry Standards for Asbestos*. 29 CFR 1926.1101

## 7 Classification of Types of Soil Disturbing Activities

The following are the classifications of soil disturbing activities under this SOP.

1. **“Localized Limited Quantity Shallow Hand Digging-** This covers localized limited quantity (less than 1 cubic yard of soil) shallow hand digging from surface to 24 inches in depth, that is typical in the normal day-to-day operations of the campus, including sprinkler repair, planting shrubs and small potted plants, and installing fence posts/signs, etc.
2. **“Small Scale” Localized Hand/Equipment Excavation-** This covers deeper (greater than 24 inches) localized excavation generating greater than 1 cubic yard of soil, and includes hand digging or small/light equipment (backhoe, mini excavator, tree planters, min-excavators, and hole drilling augers, etc) for minor utility repair, tree planning, etc. With these types of excavations, the work is a very short (day duration), and the soil is typically deposited in the same location from which it is removed, and is not typically subject to relocation.
3. **“Moderate Scale” Localized Equipment Excavation –** This covers larger scale “localized” excavations that involve trenching or pothole excavation typically to install or repair buried utilities. With these types of excavations, the work is a is short to moderate duration (days to weeks), is conducted with a moderate sized “back-hoe” or excavator” and the soil is typically deposited in the same location from which it is removed, and is not typically subject to relocation. An example of this would be utility corridor trenching.
4. **“Large Scale” Equipment Excavation –** This covers largest scale excavations that involve mass excavation of a site, usually for building construction or other site development purposes. With these types of excavations, the work is a moderate to long duration (weeks to months), is conducted with large excavators, scrapers, front end loaders, etc, and the soil is typically subject to relocation on and off-site, with potential for additional soil import, depending on final grade requirements. An example of this would be “mass excavation” performed for construction of a new building.

## 8 Excavation Notifications

The following table summarized the types of **notifications required prior to conducting soil disturbing activities**.

	Low Potential ACS condition	Moderate to High Potential ACS condition	Known ACS condition
Localized Limited Quantity (less than 3 cubic yards) Shallow Hand Digging (less than 24 inches in depth for sprinkler repair, shrub/planting small potted plants, installing fence posts/signs etc	No notification required	No notification required	No notification required
Localized Small Scale Hand/Equipment Excavation more than 3 cubic yards and greater than 24 inches in depth (minor utility repair, tree planning, etc)	No notification required	Notification to UCD prior to start	Notification to UCD and CDPHE prior to start
Moderate Scale Localized Equipment Excavation (utility trenching)	Notification to UCD prior to start	Notification to UCD prior to start	Notification to UCD and CDPHE prior to start
Large Scale Equipment Excavation (mass excavation)	Notification to UCD prior to start	Notification to UCD prior to start	Notification to UCD and CDPHE prior to start

CDPHE will be notified within 24 hours of an unexpected ACS and/or ACM discovery. CDPHE will be notified at least 10-days prior to any planned soil-disturbing activity in areas of known ACS and/or ACM. The HMWMD can be notified by using the Notification Form attached to this plan, and emailed to CDPHE contact identified in Section 3 of this SOP. If ACS is encountered and an area reclassified as “known ACS condition” that CDPHE will be notified prior to start or re-start of work.

Additional notification shall be provided to UCD if construction debris is encountered in areas determined to be low potential ACS condition. **Notification to UCD includes notification to UCD Facilities Planning Department contact and UCD Environmental Health and Safety Division contacts as provided in Section 3 of this SOP.** The Contractor shall notify and receive approval from the UCD project manager prior to any soil being exported or imported to the project. Contractor shall coordinate any inspections, spotting, or testing requested by the UCD project manager for any exported or imported soils to the project. For emergency repair projects to utilities, etc, notification will be provided to CDPHE by the next business day.

## 9 Excavation Planning

Prior to performing any soil disturbance activities, those persons performing the soil disturbing activity shall check the AMC ACS Asbestos Contaminated Soils Classification Site Drawing (Attachment #1) to determine the classified ACS condition for the area where soil disturbing activities will occur. Comply with notification, training and work procedures provisions of this document based on the classified condition for the area where excavation will occur which will be classified into one of the following three categories:

- *Low Potential ACS Condition (areas shaded green)*
- *Moderate to High Potential ACS Condition (areas shaded yellow)*
- *Known ACS Condition (shaded coded red)*

The following soil spotting activities will be utilized during all excavation activities for moderate to large scale excavation activities when moderate to high potential ACS conditions exist:

1. All surface work areas will be pre-inspected by the asbestos soil inspector prior to commencement of soil disturbance activities.
2. Excavation Area: conduct a subsurface visual inspection for asbestos material during excavation. The asbestos soil inspector will inspect all areas of the excavation as removal of soil proceeds, and will inspect the bottom of the excavation for visible ACM.
3. Stockpile and Backfill Areas: closely inspect stockpiled area as soil is dumped/piled.

Where ACS is identified and impacted by planned excavation, the characterization, removal and disposal of contaminated soil shall be conducted in accordance with the provisions of this SOP. Once the asbestos soil inspector has delineated the ACS boundaries (depth and extent through visual inspection characterization protocols as provided in Section 11 of this SOP), the Contractor may continue excavation in other non-ACS areas with continued spotting by an asbestos soil inspector.

For localized limited quantity (less than 1 cubic yard) shallow (less than 24 inches) hand digging for normal day-to-day operations, including sprinkler maintenance, installation of signs/posts, planting of small plants and shrubs, etc, these activities are exempt from this SOP since these activities typically occur in newly constructed areas with shallow digging occurring in the top fill layer placed during new construction, which has a low potential to contain asbestos debris, and less than 1 cubic yard by hand-digging is exempted under CDPHE HMWMD regulations. Notification shall be provided to UCD if construction debris is encountered under these exempted activities.

For additional planning purposes and as a reference, an historical site map is provided in Attachment #2 that shows the building and steam tunnel locations for the former Fitzsimons Army Medical Center. Attachment #3 contains a flow chart that summarizes the key components of this SOP document.

## 10 Training Requirements

### 10.1 SOP circulation

The following entities/persons involved with soil disturbing activities shall be provided a copy of this SOP prior to performing work.

1. Those performing soil disturbing activities in areas with moderate to high potential to encounter ACS
2. Those providing awareness soil training
3. Those providing soil inspection or soil spotting activities during normal excavation activities.
4. Those performing soil disturbing activities in a known ACS condition area

5. Those providing air monitoring and inspection associated with soil disturbing activities in a known ACS condition area.

## 10.2 Awareness Training

For areas with *moderate to high* potential to encounter ACS, all those persons involved with the excavation regardless of size shall be provided on the job hazard communication awareness (awareness) training for those individuals associated with the soil disturbing activities as follows:

*“On-the-job” asbestos soils awareness training as defined in Section 5.5.6 of the Solid Waste Regulations will be provided to workers directly involved in soil-disturbing activities on sites where there is known ACS or a “reason to believe” ACS may be encountered. The training will address such topics as history and background of asbestos, identifying types of asbestos, health effects, engineering controls, and actions to take when suspect asbestos materials are encountered. The training will be conducted with oversight and curriculum development by an asbestos building inspector, asbestos supervisor or project designer.*

The awareness training must provide information necessary for the individuals to perform their duties in a way that ensures compliance with the requirements of Section 5.5 of the Solid Waste Regulations. The training must be conducted by an Asbestos Supervisor, Building Inspector or Project Designer, certified in accordance with AQCC Regulation No. 8, Part B, and who has a minimum of six (6) months experience in asbestos-contaminated soil management.

## 10.3 ACS Soil Disturbance Training

For **moderate to large scale excavation** activities in areas with **known ACS**, provide on the job hazard communication awareness training for those individuals associated with the soil disturbing activities. In addition personnel overseeing, directing, inspecting and/or handling asbestos or asbestos-contaminated soil during soil excavation activities shall have the following minimum training and certifications:

1. At least one (1) trained supervisor (competent person) shall be on site during excavation activities (current EPA Asbestos Supervisor Certification)
2. CDPHE HMWMD training required for persons performing asbestos-contaminated soil disturbing activities including on the job asbestos contaminated soil awareness training and training in accordance with OSHA standard 1926.1101 (k) (9) (vii) for those performing soil disturbing activities in an area with asbestos waste or asbestos contaminated soil (EPA Asbestos Supervisor/Worker training is recommended).
3. A current annual physical with medical release / respirator usage form and respirator fit test.

This training requirement applies to equipment operators but is not required for drivers of trucks carrying contaminated material for disposal to approved landfills. Drivers are only required to complete the awareness training.

For **Small Scale excavation** activities with **known ACS**, provide awareness training for those individuals associated with the soil disturbing activities. In addition personnel overseeing, directing, inspecting and/or handling asbestos or asbestos-contaminated soil during small scale soil excavation activities shall have the following minimum training and certifications:

1. At least one (1) trained supervisor (competent person) shall be on site during excavation activities.
2. CDPHE HMWMD training required for persons performing asbestos-contaminated soil disturbing activities including on the job asbestos contaminated soil awareness training and training in accordance with OSHA standard 1926.1101 (k) (9) (vii) for those performing soil disturbing activities in an area with asbestos waste or asbestos contaminated soil (Training Equivalent with OSHA Class III training for “small scale short duration” activities that will disturb asbestos recommended).

3. A current annual physical with medical release / respirator usage form and respirator fit test.

#### **10.4 ACS Inspection and Air Monitoring Training**

Individuals performing soil inspection and identification of asbestos in soil must have a current asbestos Building Inspector certification in accordance with AQCC Regulation No. 8, Part B, and must have a minimum of six (6) months experience conducting asbestos-contaminated soil inspections. Individuals with this level of training and experience are referred to in this SOP as “asbestos soil inspectors”.

Individuals preparing and signing Soil Characterization and Management Plans must have a current Asbestos Project Designer certification in accordance with AQCC Regulation No. 8, Part B.

Individuals performing asbestos air monitoring associated with asbestos-contaminated soil disturbing activities must have a current Air Monitoring Specialist certification in accordance with AQCC Regulation No. 8, Part B

#### **10.5 Additional Considerations**

In addition, individuals with the potential for exposure to asbestos fibers should be trained in the proper usage of personal protective equipment and have a current annual physical with a medical release/respirator usage form in accordance with the employer’s medical surveillance program. Personal exposure air monitoring should be conducted in accordance with the employer’s exposure assessment program.

## 11 ACS Characterization Protocols and Trigger Levels

The following summarizes the potential conditions that may be encountered during soil disturbing activities at the AMC:

1. Localized areas of **friable and/or nonfriable** asbestos debris in soil that constitute “significant quantity” as provided under the “trigger level” of this plan. Triggering “major” response procedures as provided in this plan.
2. Localized areas of **friable and/or nonfriable** debris in soil that constitute “limited quantity” as provided under the “trigger level” portion of this plan, triggering “minor” spill response during planned excavation spotting activities.
3. Localized areas with construction debris with no asbestos debris, such as brick, metal, and PVC pipe, and non-asbestos suspect debris (confirmed by bulk sampling).
4. Localized areas where no visible construction debris, or visible suspect asbestos containing materials are present.

To provide a basis for appropriate level of assessment (limited vs. significant) and management for discovered asbestos debris, the following summarizes specific trigger levels to be used under this SOP. These trigger levels are “**limited quantity discovery**” and “**significant quantity discovery**” of **visible friable and/or nonfriable asbestos debris** and have corresponding assessment and response actions based on the limited or significant finding:

### 11.1 Limited Quantity Material Discovery Assessment and Management Protocol

**Entry into Limited Quantity Assessment and Management Protocols:** Where up to 3 pieces (with multiple pieces of asbestos within a few inches of each other to be treated as one piece of asbestos) of friable and/or nonfriable asbestos debris are identified within a 10-foot radius, record the locations with a GPS unit, photograph and log pertinent information such as location, description of material, type of debris, etc.

**Exit from Limited Quantity Assessment and Management Protocols:** Carefully wet and remove the visible debris and 3 cubic feet of soils surrounding each debris piece. All debris will be adequately wetted, and removed by appropriately trained and protected personnel. All debris and associated soil will be placed into appropriately labeled disposal bags, for proper disposal based on the material friability.

### 11.2 Significant Quantity Material Discovery Assessment and Management Protocol

**Entry into Significant Quantity Assessment and Management Protocols:** Where greater than 3 pieces (with multiple pieces of asbestos within a few inches of each other to be treated as one piece of asbestos) of friable and/or nonfriable asbestos debris are identified within a 10-foot radius, this will constitute a debris field. The asbestos soil inspector will conduct surface and subsurface visual assessment with the assistance of excavation equipment to determine the extent and depth of the asbestos debris field. All



asbestos debris field corner points will be documented with a GPS unit, on a drawing and by photograph. Photograph and log pertinent information such as type of debris, quantity, etc.

**Exit from Significant Quantity Assessment and Management Protocols:** Removal of debris field based on a visual determination to the extent of excavation, or removal of *extent of find (EOF) plus 1 foot of soil, and removal of depth of find (DOF) plus 1 foot of soil for subsurface contamination, and removal of extent of find (EOF) plus 1 foot of soil where only surface contamination is identified.* Where visible friable and/or nonfriable asbestos debris is still observed at the extent of planned excavation, the area will be over excavated by 1 foot, and then covered with a geotechnical membrane and labeled/demarcated as asbestos-contaminated soil, and covered with 1 foot of clean fill. The boundary will be recorded with a GPS unit, on a drawing, and by photograph.

### 11.3 Visual Characterization for Significant Discovery

Site characterization (surface and subsurface visual assessment) will be conducted by using visual inspection to identify depth and extent of visible significant debris using potholing and trenching techniques for asbestos debris. Soil sampling and analysis is not part of the characterization process under this SOP, and any collection and analysis of soil samples for asbestos content requires written authorization from UCD.

### 11.4 Surface Investigation

Surface investigation for areas identified as having potential asbestos-containing debris will be conducted for suspect asbestos debris. Surface investigation will include sampling suspect asbestos-containing material, or will assume material is asbestos-containing. Marker paint and flags will be used to demarcate locations of any suspect debris. Locations will be identified with a GPS device. The surface investigation will include photographing and logging pertinent information such as location, type of debris, quantity, etc.

### 11.5 Investigation Personal Protective Equipment

At a minimum, appropriate PPE must be worn when doing asbestos inspections or otherwise accessing an area suspected or known to contain asbestos. At a minimum, asbestos soil inspectors performing the inspection and/or personnel performing the pickup of non-friable asbestos must wear disposable booties and disposable rubber gloves, which should then be discarded as asbestos waste prior to exiting the site. At a minimum, asbestos soil inspectors performing the inspection and/or personnel performing the pickup of friable asbestos must wear a half-face air-purifying respirator with HEPA cartridge filtration, disposable protective suite, disposable booties and disposable rubber gloves. Disposable protective equipment should then be discarded as asbestos waste prior to exiting the site. Additional protective equipment shall be used as appropriate.

### 11.6 Demarcation of Discovery Locations and ACS Boundaries

Locating debris and other site conditions by GPS where specified in this SOP is considered the primary method for documenting these locations, but distance measurement (XYZ coordinate) descriptions may be used where a site grid is utilized or where locations are adjacent to structures or features. Grid/Structure reference points shall be documented with GPS in the event grid markers or structures are removed.



## 12 Limited Quantity ACS Management Procedures

Where the asbestos soil inspector visually observes up to three pieces of friable and/or nonfriable asbestos debris within a ten (10) foot radius, follow the procedures listed below.

For **nonfriable** asbestos material, adequately wet, using hand-removal methods only, gather and place the material and approximately 12 inches of surrounding soil in 6-mil poly bags. For **friable** asbestos material, adequately wet, using hand-removal methods only, gather and place material and 3 cubic feet of surrounding soil in 6-mil poly bags (double bags). Continue work with extra attention to possible additional asbestos in that vicinity. Stage waste bags in a lined drum or roll-off container. Dispose of waste as asbestos contaminated waste in accordance with CDPHE regulations and this SCMP.

All personnel involved in the removal of Limited Quantity asbestos debris will wear at a minimum a half-face air purifying respirator with HEPA filtration, and disposable protective suit, disposable overboots and disposable gloves. Decontamination of all tools and equipment involved in the removal of asbestos debris is required prior to leaving the work area. Disposable suits, overboots and gloves shall be disposed of as asbestos waste.

## 13 Significant Quantity ACS Management Procedures where only Nonfriable Asbestos Material is Present

Where the asbestos soil inspector visually observes more than three pieces nonfriable asbestos debris within a ten (10) foot radius, follow the procedures listed below.

### 13.1 Soil Wetting and Stabilization

The Work Area will be adequately wetted to prevent any fugitive dust emissions that may be generated during initial setup and mobilization into the area. The Contractor shall use water hoses from a tank truck or directly from a fire hydrant or other water source. Water will be applied at low pressure so as to not generate dust or splattering. During all soil disturbing activities, wetting of soil will be sufficient to ensure soils are adequately wet (no visibly dry soil and no visible emissions) throughout the soil disturbing activities.

### 13.2 Dust and Emissions Control

General dust control will be achieved by use of water trucks that will regularly spread water on all access roads throughout the project site to ensure no visible dust generation by vehicle traffic during soil disturbance activities. Whenever contaminated soil and debris are being impacted, the Contractor will ensure that no emissions are generated. UCD's representative will be on site to monitor the moisture of the soil being skimmed during removal and will ensure that it is adequately wet (and to observe for any visible emissions). An asbestos soil inspector will conduct these visual inspections.

If emissions are observed during the removal process, activities will immediately cease and work practices will be reviewed and modified by the Contractor. The Consultant will log all instances where visible dust emissions occurred and immediately notify UCD and CDPHE by phone and in writing, of all occurrences, and will obtain any direction from UCD and CDPHE.

### 13.3 PPE

During the actual soil disturbance activity, all persons within the designated work area shall utilize appropriate personal protective equipment, including appropriate respiratory protection with a minimum half face respirator with HEPA filtration required anytime active soil disturbance is occurring, protective full body tyvek<sup>®</sup> suit with attached

hood and booties, gloves, rubber boots, and other protective wear as appropriate based on conditions (cold stress, heat stress, insects, etc)

### **13.4 Removal/Excavation**

The Contractor will remove adequately wet soil in lifts with the lift thickness is determined by the depth of the adequately wet soil. The application of amended water to work area will be completed in accordance with all applicable regulations, variances, the work plan, and the on-site observations by the Consultant. Polyethylene sheeting will be placed over uncontaminated soils in the swing radius of the excavator or along the transport route of loading equipment to prevent cross-contamination. Care will be taken to avoid contamination of the excavating equipment. This will be accomplished by driving and keeping excavating equipment on non-contaminated soil.

Equipment that comes in contact with contaminated soil, or that was within the designated work area will be decontaminated. Conduct work with appropriate phasing/sequencing that will minimize cross-contamination potential.

### **13.5 Wind and Work Stoppage Conditions**

Soil disturbance operations will not be conducted if winds produce visible emissions of dust or create dust when moving equipment or soil.

### **13.6 Environmental Monitoring**

During the execution of the soil removal, the AMS will collect air samples to assist in determining the adequacy of the engineering and environmental controls employed at the site. Air monitoring will be conducted during ACS significant discovery soil removal activities where only nonfriable material is visible. All air samples will be collected by a CDPHE certified Air Monitoring Specialist (AMS).

The air monitoring is described below.

1. **Sampling Media:** Air samples will be collected by drawing air through a 25-millimeter mixed cellulose ester filter, 0.8-micron pore size, with an open-faced, long cowl using low-flow personal sampling pumps at approximately 2 liters per minute (or flow rate to provide a sufficient LOQ/LOD). Each low-volume pump will be fitted with a computer microchip, which electronically regulates airflow and allows a fixed flow rate of air to pass over the face of the filter. The flow rate and the volume of air passed through the filter will be determined based on the National Institute for Occupational Safety and Health (NIOSH) 7400 analytical method. Each pump will be calibrated before and after the collection of each sample using a primary standard.
2. **Sample Analysis:** Sample analyses will be performed by a microscopist using a phase contrast microscope (PCM) according to the NIOSH 7400 Method. The microscopist will be a CDPHE certified Air Monitoring Specialist (AMS) and a participant in the NIOSH Proficiency Analytical Testing Program and have been deemed proficient. Analyses of transmission electron microscopy (TEM) air samples will be submitted to a National Institute for Standards and Technology National Voluntary Laboratory Accreditation Program accredited laboratory using TEM according to Asbestos Hazard Emergency Response Act protocol.
3. The daily air monitoring sampling scheme will be as follows:
  - a. Air samples will be strategically placed as close to work area without impeding equipment and worker activity, and will be collected continuously during excavation and loading operations and submitted the same day for PCM analysis. **A total of 5 samples will be collected per shift per work area.**
  - b. Of the 5 samples collected, three (3) perimeter samples will be placed to triangulate the work area, moving as necessary to follow the active “area-of-disturbance”, but *remaining fixed in relation to each other*. One (1) additional perimeter “floating sample” will be placed downwind from work activities, where potential fiber emissions are most likely to be detected. All perimeter samples shall be collected as close to the “point of disturbance” as possible, without subjecting the air monitoring equipment to damage from the operations. One (1) additional sample, to be considered the potential worst-case scenario “area equivalent” sample, will be collected on personnel closest to disturbance operations, such as the person operating the water hose.
  - c. The results from these samples for comparison to 0.01 f/cc (and presence of asbestos for when analyzed by TEM) and should not be construed as “OSHA exposure assessment air samples”.
  - d. **Performance Based Air Sampling:** Five (5) samples, including personnel and perimeter samples, will be submitted for PCM analysis. If analysis yields results with detectable fiber levels (based on fiber count) then TEM analysis will be conducted on the two (2) highest PCM samples for the first 3 days of each nonfriable excavation event. If no asbestos fibers are detected after the first 3 days of each event, then TEM analysis of the two (2) highest PCM samples will be reduced, to be conducted randomly twice per week. The AMS will determine on which two days *TEM analysis* will be conducted. TEM analysis will continue to be performed on any sample with PCM results exceeding 0.01 fibers/cc. .
4. PCM verbal results will be made available by the start of the next business day or as soon as practical after the start of the next business day. TEM verbal results will be made available within 24-hours of receipt of samples by the laboratory, and written results will be made available within 24 hours from the time the verbal result is received. UCD and CDPHE will be immediately notified if any sample results show any concentration of airborne fibers. If any asbestos fibers are detected by TEM, all investigative activities will be stopped and engineering controls will be evaluated by Contractor and Consultant, and will be discussed with UCD and CDPHE to determine if changes in engineering controls or additional PPE are required.
5. As an alternative to Environmental Air Monitoring for significant quantity nonfriable excavation, where soil sampling is performed in areas containing only visible nonfriable asbestos debris (per a soil sampling plan as agreed upon by UCD and CDPHE), and where soil sampling data demonstrates that no asbestos is present in the soil, and excavation work practices will not render the nonfriable material friable, environmental air monitoring may be reduced to PCM on workers only with the written approval of UCD and CDPHE.

### 13.7 Personal Air Monitoring

Air sampling of personnel is an employer based responsibility, and as such shall be the responsibility of each employer associated with soil disturbing activities. The “area equivalent” samples collected on personnel are

interpreted as “worst case area” samples and are not intended to provide OSHA exposure information, but can be used by employers for general informational purposes.

### **13.8 Truck/Container Staging/Lining and Waste Loading**

All truck drivers will be instructed to close all windows and shut-off air delivery systems (fans on air-conditioning and heating systems) when entering the loading area. All travel and positioning of waste transport Truck/Trailers on the site should be visually verified clean soil to minimize the need for decontamination procedures. At the loading location, install a ten-mil polyethylene sheeting or thicker “lay-down pad” that will be placed on the ground under dumpsters/trucks to catch any spilled material. Spilled material will be cleaned up immediately and not allowed to dry out or accumulate. Additional poly shall be draped over trailer tires/fenders to minimize the need for decontamination after loading. After the load has been secured, and the load cover tarp is installed, the poly sheeting lay down loading pad will be properly decontaminated using wet wipe and or HEPA vacuuming methods. The loaded transportation truck may then proceed down the designated exit route.

### **13.9 Waste Transportation and Disposal**

Containers of nonfriable asbestos waste, asbestos-contaminated soil with visible nonfriable asbestos, or ACS with no visible asbestos will be labeled, in accordance with the requirements of Section 5.2 of the Solid Waste Regulations. In accordance with the disposal requirements for nonfriable asbestos waste at least one 6-mil polyethylene liner/sheeting will be in trucks used for transport of soil that contains visible nonfriable asbestos. Polyethylene liners/sheeting should be designed and sized for the container to be used and should be folded over sides of trailers or containers to protect against contamination during loading and to facilitate decontamination. After loading, the liners/sheeting will be sealed and mechanically fastened in a manner that ensures that it remains intact and leak-tight during transportation and disposal operations. Containers of nonfriable asbestos waste, asbestos-contaminated soil with visible nonfriable asbestos, and asbestos-contaminated soil with no visible asbestos, shall be labeled noting “asbestos, danger” and the generator, and placed on top of sealed liner.

In addition, Department of Transportation (DOT) asbestos placards shall be placed on all four vertical sides of the container or vehicle being used for transport of ACS. The Contractor should direct the schedule of transportation of asbestos-contaminated soil. When loaded, each truck should be assigned a manifest to serve as the shipping document for that particular load.

Asbestos-contaminated soil shall be transported and disposed in a leak tight container in accordance with the CDPHE disposal requirements. Documentation stating that the soil originating from the site will not be used as daily cover or sold as clean fill shall accompany each load of asbestos-contaminated soil removed from the site.

Disposal of asbestos-contaminated soil will be conducted in accordance with the following requirements, in accordance with Section 5.5.7 of the Solid Waste Regulations:

1. Asbestos-contaminated soil containing only visible nonfriable asbestos, that has not been rendered friable, will be disposed of as nonfriable asbestos in accordance with Section 5.2 of the Solid Waste Regulations.
2. Asbestos-contaminated soils containing no visible asbestos will be disposed in a manner similar to nonfriable asbestos waste, as described in Section 5.2 of the Solid Waste Regulations.

### **13.10 Personnel Decontamination**

A fully functioning 3-chamber decontamination trailer (or equivalent) will be placed outside the work zone to function as a remote shower location, with a clean room and an equipment room. All workers involved in removal/packaging ACS will be double suited while in the work area and will shed one suit prior to leaving the work area and immediately proceed to the decontamination facility. All workers will decontaminate per OSHA regulations and CDPHE Regulation No. 8. Decontamination water will be filtered using a 5 micron filter, or in accordance with local requirements if more stringent, prior to disposal to the sanitary sewer.

### **13.11 Equipment Decontamination**

All equipment and tools that come into contact with, or are used for removal of ACS will be decontaminated (free of all visible dust and debris) using wet cleaning (fire hose for trackhoe equipment, wet rags for hand tools, etc) and HEPA vacuuming methods (interior of equipment cab, etc), prior to leaving the work zone. Equipment decontamination will be conducted within a decontamination station constructed adjacent to the work zone. The decontamination station will be constructed of 10-mil polyethylene sheeting (and other materials as necessary, such as EPDM rubber roofing, etc) in such a way as to capture all contaminated material and wastewater from the decontamination process. All waste water from the decontamination station will be filtered to a minimum of 5-microns (or in accordance with local requirements if more stringent, prior to discharge to a sanitary sewer), or may be used for wetting ACS.

### **13.12 Final Inspection Procedures**

As the project progresses, visual inspection will be performed to ensure that all observable asbestos-containing materials have been removed from the soil surface. During removal of soil, the soil will be removed in a manner that will provide a flat, even surface (with no spoil piles) for visual inspection. The inspections will be performed for the surface area removed that day, as a preliminary inspection. Due to the wet nature of the removal and the soil, adequate drying time is required before a final visual inspection can be conducted.

The removal of soil in the debris field area will be considered complete when the visible asbestos-containing material has been removed and an asbestos soil inspector makes a final decision that all contaminated soil in the debris field has been removed to depth and extent of excavation (where remaining visible material will be covered with a membrane and labeled), or depth of find plus 1 foot of soil (DOF+1) and extent of find plus 1 foot of soil (EOF+1).

### **13.13 Managing ACS left in place**

Where visible asbestos containing material is observed at the depth and extent of excavation, 1 additional foot of soil shall be removed, the area shall be covered with a geotech membrane, labeled as asbestos contaminated soil, and then the membrane shall be covered with 1 foot of clean fill to bring back to desired grade/level. Prior to covering with clean fill, photographs will be collected from each compass point of the boundary, and the corner points of the boundary shall be obtained using measurements for a control point or with a GPS device.

## **14 Significant Quantity ACS Management Procedures where Friable Asbestos Material is Present**

Where the asbestos soil inspector visually observes more than three pieces friable asbestos debris within a ten (10) foot radius, follow the procedures listed below.

### **14.1 Site Control, Demarcation, Fencing and Wind Screening**

The Work Area will be demarcated on all four sides using a movable/portable wind barrier to prevent wind dispersal of soil during excavation activities. Moveable/portable wind barriers will be placed on all four sides and immediately adjacent to the point of excavation, and will be of adequate height and configuration (size) to minimize wind soil dispersal at the point of excavation. For smaller areas or highly mobile removal activities, moveable “directional” mobile wind fencing may be used, but must be positioned upwind and adjacent to soil removal activities at all times. Where only directional wind fencing is used, asbestos barrier tape shall be installed to identify the remaining boundary of the Work Area (where wind fence is not positioned).

## **14.2 Protection of Adjacent Structures**

When the abatement area is close to occupied structures, external critical barriers may need to be constructed. All openings in the structure, including windows, doorways, vents or other openings will be sealed with 6-mil poly.

## **14.3 Soil Wetting and Stabilization**

The Work Area will be adequately wetted to prevent any fugitive dust emissions that may be generated during initial setup and mobilization into the area. The Contractor shall use water hoses from a tank truck or directly from a fire hydrant or other water source. Water will be applied at low pressure so as to not generate dust or splattering. During all soil disturbing activities, wetting of soil will be sufficient to ensure soils are adequately wet (no visibly dry soil and no visible emissions) throughout the soil disturbing activities.

## **14.4 Dust and Emissions Control**

General dust control will be achieved by use of water trucks that will regularly spread water on all access roads throughout the project site to ensure no visible dust generation by vehicle traffic during soil disturbance activities.

Amended water and or stabilization agents will be applied for dust control within all disturbed ACS areas. The Contractor will maintain the dust control process throughout the course of the project during soil disturbing activities. Removal of soils and debris will be done with heavy equipment which has been adapted to have a water misting system installed on the equipment to minimize dust emissions at the point of removal. Water will be applied in a manner that does not cause run-off or splattering. In addition, a water misting system will be constructed to wet the material at the point of loading into the dumpster prior to final packaging.

Whenever contaminated soil and debris are being impacted, the Contractor will ensure that no emissions are generated. UCD's representative will be on site to monitor the moisture of the soil being skimmed during removal and will ensure that it is adequately wet (and to observe for any visible emissions). An asbestos soil inspector will conduct these visual inspections.

Site management and inspectors will monitor the quantity of surface area disturbed at any given time; also the amount of surface not stabilized will be kept to the minimum quantity necessary for meaningful work to occur. If site conditions change so that dust suppression becomes questionable on the amount of disturbed area, a portion of that area will be stabilized and work will proceed on a reduced area.

If emissions are observed during the removal process, activities will immediately cease and work practices will be reviewed and modified by the Contractor. The Consultant will log all instances where visible dust emissions occurred and immediately notify UCD and CDPHE by phone and in writing, of all occurrences, and will obtain any direction from UCD and CDPHE.

## **14.5 PPE**

During the actual soil disturbance activity, all persons within the designated work area shall utilize appropriate personal protective equipment, including appropriate respiratory protection with a minimum half face respirator with HEPA filtration required anytime active soil disturbance is occurring, protective full body tyvek<sup>®</sup> suit with attached hood and booties, gloves, rubber boots, and other protective wear as appropriate based on conditions (cold stress, heat stress, insects, etc)

## **14.6 Removal/Excavation**

Utilizing an excavator, mini excavator or backhoe with a bucket mounted spray bar system; the soil excavation will proceed within the designated work area. The spray bar system will consist of nozzles inside the back top edge of the bucket and two outside the bucket with nozzles spray pattern overlapping that will provide adequate wetting to



eliminate fugitive dust, but avoid splatter or drift from spraying. Additional hand wetting will be used to eliminate fugitive emissions, but avoid splatter or drift from spraying.

The Contractor will remove adequately wet soil in lifts with the lift thickness is determined by the depth of the adequately wet soil. The application of amended water to work area will be completed in accordance with all applicable regulations, variances, the work plan, and the on-site observations by the Consultant. Polyethylene sheeting will be placed over uncontaminated soils in the swing radius of the excavator or along the transport route of loading equipment to prevent cross-contamination. Care will be taken to avoid contamination of the excavating equipment. This will be accomplished by driving and keeping excavating equipment on non-contaminated soil.

Equipment that comes in contact with contaminated soil, or that was within the designated work area will be decontaminated. Conduct work with appropriate phasing/sequencing that will minimize cross-contamination potential.

## 14.7 Wind and Work Stoppage Conditions

Soil disturbance operations will not be conducted if winds produce visible emissions of dust or create dust when moving equipment or soil. All wind speed measurements will be taken at locations in close proximity to, and representative of, the work area in which the soil is being handled.

**Shutdown conditions:** Soil removal/disturbance operations will immediately and temporarily cease when one or more of the following 4 conditions have been met:

1. Any wind gust reaching or exceeding 20 mph as determined by hand-held instruments;
2. Sustained wind speeds reaching or exceeding 12 mph averaged over a period of 10 minutes;
3. Winds are producing visible emissions or creating movement of dust or debris in or near the removal/disturbance area, or
4. Winds are impacting on the ability of engineering controls to work as designed.

During wind-related work shutdowns, other work activities not involving soil removal or disturbance (e.g., lining dumpsters) may continue.

**Resume Conditions:** Soil disturbance activities may resume after all of the following 4 conditions have been met:

1. All wind gust readings for a period of 20 minutes drop below 20 mph as determined by hand-held instruments;
2. Sustained wind speeds are below 12 mph averaged over a period of 20 minutes;
3. Winds are no longer producing visible emissions or creating movement of dust in or around the removal/disturbance area, and
4. Winds are not impacting on the ability of engineering controls to work as designed.

## 14.8 Environmental Monitoring

During the execution of the soil removal, the AMS will collect air samples to assist in determining the adequacy of the engineering and environmental controls employed at the site. Air monitoring will be conducted during ACS significant discovery soil removal activities where visible friable asbestos material is present. All air samples will be collected by a CDPHE certified Air Monitoring Specialist (AMS). The air monitoring is described below.

1. **Sampling Media:** Air samples will be collected by drawing air through a 25-millimeter mixed cellulose ester filter, 0.8-micron pore size, with an open-faced, long cowl using low-flow personal sampling pumps at approximately 2 liters per minute (or flow rate to provide a sufficient LOQ/LOD). Each low-volume pump will be fitted with a computer microchip, which electronically regulates airflow and allows a fixed flow rate of air to pass over the face of the filter. The flow rate and the volume of air passed through the

filter will be determined based on the National Institute for Occupational Safety and Health (NIOSH) 7400 analytical method. Each pump will be calibrated before and after the collection of each sample using a primary standard.

2. **Sample Analysis:** Sample analyses will be performed by a microscopist using a phase contrast microscope (PCM) according to the NIOSH 7400 Method. The microscopist will be a CDPHE certified Air Monitoring Specialist (AMS) and a participant in the NIOSH Proficiency Analytical Testing Program and have been deemed proficient. Analyses of transmission electron microscopy (TEM) air samples will be submitted to a National Institute for Standards and Technology National Voluntary Laboratory Accreditation Program accredited laboratory using TEM according to Asbestos Hazard Emergency Response Act protocol.
3. The daily air monitoring sampling scheme will be as follows:
  - a. Air samples will be strategically placed as close to work area without impeding equipment and worker activity, and will be collected continuously during excavation and loading operations and submitted the same day for PCM analysis. **A total of 8 samples will be collected per shift per work area.**
  - b. Of the 8 samples collected, four (4) samples will be arranged at the 4 points of the compass surrounding the work area with two (2) additional samples deemed as "perimeter floating samples". The perimeter floating samples will be placed in areas where emitted asbestos fibers are most likely to be detected (downwind from work activities). Two potential worst-case scenario "area equivalent" samples will be collected on at least 2 workers who are expected to have the greatest potential exposure to asbestos during abatement operations. The results from these samples are for comparison to 0.01f/cc (and presence of asbestos for when analyzed by TEM) and should not be construed as "OSHA exposure assessment air samples".
4. Eight (8) samples, including personnel and perimeter samples, will be submitted for PCM analysis. If analysis yields results with detectable fiber levels (based on fiber count) then TEM analysis will be conducted on two (2) highest PCM samples to evaluate engineering controls. After two (2) weeks of TEM sampling, the analytical results and engineering controls will be assessed to determine if adequate controls are in place. If controls are deemed adequate by UCD and CDPHE, the number of *TEM samples* may be reduced as approved by UCD and CDPHE. On an ongoing project basis, any sample with PCM results exceeding 0.01 fibers/cc must be analyzed by TEM. For large areas of disturbance, additional perimeter monitoring points shall be added if the active area of soil disturbance is larger than approximately 1 acre in size. One additional monitoring point should be added for each additional 200 linear feet of perimeter (approximately 1 sample per additional ¼ acre increase in area). For active areas of soil disturbance greater than 1 acre, additional samples shall be analyzed by TEM at a minimum rate of 25% of the total number of samples collected, based on highest PCM results. However, TEM analysis is not required if PCM results are non-detect (based on fiber count).
5. PCM verbal results will be made available by the start of the next business day or as soon as practical after the start of the next business day. TEM verbal results will be made available within 24-hours of receipt of samples by the laboratory, and written results will be made available within 24 hours from the time the verbal result is received. UCD and CDPHE will be immediately notified if any sample results show any concentration of airborne fibers. If any asbestos fibers are detected by TEM, all investigative activities will be stopped and engineering controls will be evaluated by Contractor and Consultant, and will be discussed with UCD and CDPHE to determine if changes in engineering controls or additional PPE are required.

## 14.9 Personal Air Monitoring

Air sampling of personnel is an employer based responsibility, and as such shall be the responsibility of each employer associated with soil disturbing activities. The "area equivalent" samples collected on personnel are interpreted as "worst case area" samples and are not intended to provide OSHA exposure information, but can be used by employers for general informational purposes.

## 14.10 Truck/Container Staging/Lining and Waste Loading

All truck drivers will be instructed to close all windows and shut-off air delivery systems (fans on air-conditioning and heating systems) when entering the loading area. All travel and positioning of waste transport Truck/Trailers on the site should be visually verified clean soil to minimize the need for decontamination procedures. At the loading location, install a ten-mil polyethylene sheeting or thicker "lay-down pad" that will be placed on the ground under



dumpsters/trucks to catch any spilled material. Spilled material will be cleaned up immediately and not allowed to dry out or accumulate. Additional poly shall be draped over trailer tires/fenders to minimize the need for decontamination after loading. After the load has been secured, and the load cover tarp is installed, the poly sheeting lay down loading pad will be properly decontaminated using wet wipe and or HEPA vacuuming methods. The loaded transportation truck may then proceed down the designated exit route.

To accomplish proper characterization of soil (preliminary visual inspection and verification visual inspection at staging area), movement of soil to staging areas for subsequent loading, transportation and disposal is necessary. Staged soil must be stabilized when loading is not occurring. Upon removal of staged ACS placed on “non-ACS area”, the contractor shall remove an additional 12 inches of soil to address any cross-contamination that may have occurred to the non-ACS area.

### **14.11 Waste Transportation and Disposal**

Containers of friable asbestos waste, or asbestos-contaminated soil with visible friable asbestos, shall be labeled, in accordance with the requirements of Section 5.3 of the Solid Waste Regulations. In accordance with the disposal requirements for friable asbestos waste (Section 5.3.5(A) of the Solid Waste Regulations) at least two 6-mil polyethylene liners/sheeting shall be used for soil that contains visible friable asbestos. Polyethylene liners/sheeting should be designed and sized for the container to be used and should be folded over sides of trailers or containers to protect against contamination during loading and to facilitate decontamination. After loading, both liners/sheeting should be mechanically fastened and sealed separately. The liners/sheeting shall be sealed in a manner that ensures that they remain then leak-tight during transportation and disposal operations.

In addition, Department of Transportation (DOT) asbestos placards shall be placed on all four vertical sides of the container or vehicle being used for transport of ACM/ACS. The Contractor should direct the schedule of transportation of asbestos-contaminated soil. When loaded, each truck should be assigned a manifest to serve as the shipping document for that particular load.

Asbestos-contaminated soil shall be transported and disposed in a leak tight container in accordance with the CDPHE disposal requirements. Documentation stating that the soil originating from the site will not be used as daily cover or sold as clean fill shall accompany each load of asbestos-contaminated soil removed from the site.

Disposal of asbestos-contaminated soil will be conducted in accordance with the following requirements, in accordance with Section 5.5.7 of the Solid Waste Regulations:

1. Asbestos-contaminated soils containing visible friable asbestos will be disposed in a leak tight container as friable asbestos waste in accordance with the requirements of Section 5.3 of the Solid Waste Regulations.

### **14.12 Personnel Decontamination**

A fully functioning 3-chamber decontamination trailer (or equivalent) will be placed outside the work zone to function as a remote shower location, with a clean room and an equipment room. All workers involved in removal/packaging of friable or significant quantities of nonfriable ACM will be double suited while in the work area and will shed one suit prior to leaving the work area and immediately proceed to the decontamination facility. All workers will decontaminate per OSHA regulations and CDPHE Regulation No. 8. Decontamination water will be filtered using a 5 micron filter, or in accordance with local requirements if more stringent, prior to disposal to the sanitary sewer.

### **14.13 Equipment Decontamination**

All equipment and tools that come into contact with, or are used for removal of ACS will be decontaminated (free of all visible dust and debris) using wet cleaning (fire hose for trackhoe equipment, wet rags for hand tools, etc) and HEPA vacuuming methods (interior of equipment cab, etc), prior to leaving the work zone. Equipment decontamination will be conducted within a decontamination station constructed adjacent to the work zone. The

decontamination station will be constructed of 10-mil polyethylene sheeting (and other materials as necessary, such as EPDM rubber roofing, etc) in such a way as to capture all contaminated material and wastewater from the decontamination process. All waste water from the decontamination station will be filtered to a minimum of 5-microns (or in accordance with local requirements if more stringent, prior to discharge to a sanitary sewer), or may be used for wetting ACS.

#### **14.14 Final Inspection Procedures**

As the project progresses, visual inspection will be performed to ensure that all observable asbestos-containing materials have been removed from the soil surface. During removal of soil, the soil will be removed in a manner that will provide a flat, even surface (with no spoil piles) for visual inspection. The inspections will be performed for the surface area removed that day, as a preliminary inspection. Due to the wet nature of the removal and the soil, adequate drying time is required before a final visual inspection can be conducted

The removal of soil in the debris field area will be considered complete when the visible asbestos-containing material has been removed and an asbestos soil inspector makes a final decision that all contaminated soil in the debris field has been removed to depth and extent of excavation (where remaining visible material will be covered with a membrane and labeled), or depth of find plus 1 foot of soil (DOF+1) and extent of find plus 1 foot of soil (EOF+1).

#### **14.15 Managing ACS left in place**

Where visible asbestos containing material is observed at the depth and extent of excavation, 1 additional foot of soil shall be removed, the area shall be covered with a geotech membrane, labeled as asbestos contaminated soil, and then the membrane shall be covered with 1 foot of clean fill to bring back to desired grade/level. Prior to covering with clean fill, photographs will be collected from each compass point of the boundary, and the corner points of the boundary shall be obtained using measurements for a control point or with a GPS device.

#### **14.16 Spill Control**

Where asbestos contaminated soil is spilled during loading or transport, the Contractor shall immediately ensure the spilled material is immediately collected in accordance with wetting and emission control provisions of this SCMP. For spills that occur on clean soil, remove 12 inches of soil under spill area as precautionary measure. For spills that occur on hard surfaces such as asphalt roadways or concrete parking lots, provide wet cleaning and HEPA vacuuming until all visible dust and debris have been removed.

Where water run-off occurs resulting in visible erosion and sediment transfer from asbestos contaminated soil areas to non-asbestos contaminated soil areas, remove top 12 inches of soil where the visible erosion and sediment deposition occurred.

#### **14.17 Erosion Control**

To control wind erosion of ACS, use of silt fencing or wind fencing may be used, where appropriate. Stabilize asbestos containing soil with friable debris by covering with magnesium chloride (or equivalent soil stabilizer) or 6-mil poly until removal can occur. Securely fasten poly sheeting to prevent removal by the wind.

To control water erosion, the use of silt fencing, erosion control mats, straw waddles or equivalent erosion control methods shall be used in areas where run-off is likely. Where ACS will remain, cover with geotech membrane, and then cover with 12 inches of clean fill and cover with appropriate vegetative growth or ground cover to prevent erosion.

## **15 Special Considerations**

### **15.1 Emergency Buried Utility Repair Projects**

Specific provisions of this SOP require some planning and response time that may not be appropriate in an emergency response situation to repair a buried utility. This section identifies the minimum requirements under this SOP for the first 24 hours of excavation and repair, to ensure that necessary repairs can be made to buried utilities promptly in an emergency situation where the utility must be repaired immediately (which may include evening and weekend work), where ACS is encountered during the emergency response, only worker protection, adequate wetting and no visible emission provisions of this SOP will apply within the first 24 hours, with remaining provisions including material characterization, soil training, air monitoring, disposal, etc to take effect after the first 24 hours of the excavation and repair. By ensuring adequate wetting and no visible emissions during emergency excavation during the first 24-hours, this will allow necessary work to continue, and will provide a window for implementing remaining provisions of this SOP including testing of suspect materials and where ACS is identified, and for implementing management actions under this SOP. Where suspect material is identified in soil that has been excavated during the emergency repair, this soil shall not be placed back into the hole/pit until characterization can be conducted by an asbestos soil inspector.

### **15.2 Importing and Exporting Soil**

The Contractor shall notify and receive approval from the UCD project manager prior to any soil being exported or imported to the project. Contractor shall coordinate any inspections, spotting, or testing requested by the UCD project manager for any exported or imported soils to the project.

### **15.3 Building Demolition Debris Removal Verification**

To ensure demolition debris is removed during the demolition phase in accordance with applicable regulations, an asbestos soil inspector will conduct a site inspection during the final stage of demolition to determine if all demolition debris has been removed. As a precautionary measure, as part of the final demolition site cleaning, a layer of clean soil should be removed to ensure no construction debris remains upon completion of the demolition process as verified by inspection by an asbestos soil inspector, with the exception of non-asbestos-containing/contaminated “structural” fill such as concrete and brick as approved by UCD.

### **15.4 Soil Stockpiling Management Procedures**

Stockpiling of asbestos contaminated soils will only occur under CDPHE and UCD approval, as removal of contaminated soil will be under a direct load approach unless otherwise approved by UCD and CDPHE. When soil movement and stockpiling is necessary, based on site logistics, stockpiled soil must be stabilized and covered when not in use, and must not be allowed to remain on site longer than 5 working days.

For excavation and stockpiling of non-asbestos contaminated soils that are subject to “soil spotting provisions” (moderate to high potential ACS), an asbestos soil inspector will be present at all areas where stockpiled soils are placed, and will be in radio communication with the asbestos soil inspector inspecting soils at the excavation point to ensure prompt and efficient response to discovery of visible ACM debris at either location.

### **15.5 Management Practices for Significant Discovery of only Nonfriable materials**

Where only nonfriable materials are observed (no friable debris) in a significant discovery “debris field”, the following are required procedures:

1. Ensure material and soil is adequately wet and no visible emission occur during excavation and loading activities.

2. Packaging and disposal as nonfriable asbestos containing waste material.

## 15.6 Soil Sampling

The primary method for determining asbestos contaminated soil under this SOP and under CDPHE HMWMD regulation is visual identification of suspect material that is confirmed or presumed to be asbestos. Soil sampling is considered an optional activity and will be conducted only with UCD written authorization to conduct soil sampling on the campus. There are two primary situations where UCD may authorize soil sampling:

1. Soil sampling to provide general information about imported or exported soils as part of the management procedures under the SOP.
2. UCD written authorization to conduct soil sampling in conjunction with “Remediation” actions (as provided in Attachment #5) conducted to remove the full extent and depth of asbestos contaminated soil from a specified area. Remediation soil sampling may include “baseline” characterization for soil sampling collected prior to a remediation action, and will include collection of “clearance” (post-removal) soil sampling to verify removal of all asbestos (including trace amounts in soil as determined by PLM analysis).

Refer to Attachment #4 for surface soil sampling and analysis procedures.

## 15.7 Remediation

If the objective of an ACS removal activity is remediation of a specific location to remove the complete extent and depth of asbestos in soil at a specific location, including trace in soil as determined by PLM analysis, or for the purpose of obtaining a no further action determination under some other regulatory framework, such work must be in accordance with the remediation plan provided as a supplement to this SOP in Attachment #5. The remediation plan integrates the sampling and analysis plan (SAP) provided in Attachment #4 and describes soil handling and soil clearance (visual and bulk sampling) criteria. Refer to Attachment #5 for surface remediation procedures.

## 16 Project Reporting

Upon completion of soil disturbing activities, to aid in future management of site and any remaining ACS conditions known to exist, a close out report will be provided to the UCD to document work performed, and any ACS material known to exist that will remain for management.

The project close-out report shall include the following minimum components:

1. Property description and description of areas with asbestos-contaminated soils
2. Description of soil disturbing activities involving ACS (emission control procedures) and non-ACS conditions
3. Description of all field operations or daily logs
4. Containment logs (where appropriate)
5. Air Monitoring logs and analytical results associated with ACS removal actions
6. Description/results of all asbestos bulk sampling events, including sample locations descriptions and sample diagram/drawing showing sample locations
7. Analytical results associated with bulk sampling events
8. Disposal summaries and manifests
9. Maps showing excavation profiles
10. Documentation of asbestos left in place including drawings, photographs and GPS coordinates for corner points of known ACS.
11. Photographs showing pre-, during and post excavation/removal conditions
12. Accreditation and Certification documentation for activities covered under the Work Plan (Inspector, Air Monitoring Specialist, Supervisor, and Worker)

## 17 SOP Review and Revision

### 17.1 SOP Review

Annually, the UCD Facilities Planning Department contact and UCD Environmental Health and Safety Division contact as provided in Section 3 of this SOP shall review this SOP with an asbestos accredited/certified Project Designer with 6-month asbestos soil experience to identify any needed revisions to this SOP.

### 17.2 SOP Review

Based on annual review, any revisions to the SOP shall be submitted to CDPHE as a “revised” SOP with a new revision number and revision date for CDPHE review and approval.

## 18 Attachments

Attachment #1	ACS Classification and AMC Boundary Drawing (and Site Survey Drawings)
Attachment #2	Historical Buildings and Steam Tunnels Site Drawing
Attachment #3	SOP Flow Chart
Attachment #4	Soil Sampling and Analysis Plan (SAP)
Attachment #5	Remediation Plan
Attachment #6	CDPHE Notification Summary and Notification Forms

## **ATTACHMENT 1**

### **ACS CLASSIFICATION AND AMC BOUNDARY SITE DRAWING AND SITE SURVEY DRAWINGS**

**ATTACHMENT #2**

**HISTORICAL BUILDING AND STEAM TUNNEL  
SITE DRAWING**

**ATTACHMENT #3**

**SOP FLOW CHART**



## **ATTACHMENT #4**

### **SOP SUPPLEMENTAL PROCEDURES SOIL SAMPLING AND ANALYSIS PLAN (SAP)**

#### **General**

1. Sample aliquots should be collected using a scooping device (stainless steel spoon or equivalent), and transferred to a composite sample container.
2. When all aliquots have been collected, the composite sample container should be sealed and labeled with a sample number unique to the boring from which the sample was collected. The sample should be homogenized by the laboratory prior to analysis.
3. A field sampling form or log book entry should be maintained for each sample. The form or log book entry should contain the location, date and time of each sample, a description of the type of and friability of any suspect material encountered, and any observations made during sample collection.
4. Proper chain-of-custody protocols should be followed for all samples collected.

#### **Analytical Procedures**

1. Soil samples should be analyzed by PLM for bulk asbestos samples (Method – EPA/600/R-93/116). The samples should be homogenized by the laboratory prior to sample analysis.

#### **Surface Soil Sampling**

1. Divide the area to be inspected into a grid, using stakes or paint to mark grid nodes. The area of each grid square will be determined based on the size of the site, and existing knowledge of the extent and concentration of surface asbestos;
2. Grids are (50' x 50') on an X and Y axis utilizing planned north with the south west corner of each grid being the reference point for each grid site wide. X axis designation is numerical and Y axis grid designation is alphabetical.
3. Each grid point is identified in the lower left (Southwest) corner with a 48" wood lathe with pink ribbon alpha numerically (i.e. B15, CA12).
4. Sub-grids (25' x 50') rectangle grids within each (50' x 50') grid are identified with pin flags alpha numerically (i.e. B15-1, CA12-2).
5. Where grids extend beyond a scope of work boundary and/or property boundary, this boundary will be designated with a string line to delineate scope in partial grids (where grids overlay on scope of work or property boundary).
6. Using flags, paint or GPS, mark locations of any suspected asbestos found;
7. Record locations of suspected asbestos found using a map, log or other documentation. The absence of asbestos in a grid square will also be documented;
8. Place suspected asbestos material in a sample bag, adequately wetting it prior to disturbing it; and record time and date, location and description of material collected.
9. A composite aliquot soil sample will be collected within each sub-grid 1,250 square feet (25' x 50') by an asbestos soil inspector. The asbestos soil inspector will collect ten aliquots of surface soil (top 1 inch) within each sub-grid. Two sample aliquots will be collected from the southwest quadrant, southeast quadrant, northwest quadrant, northeast quadrant, and the relative center of

the sub-grid (totaling ten aliquots per sub-grid). A grid will be considered an asbestos contaminated soil grid where soil sampling data reports the presence of asbestos in any sub grid within that grid (thus progressive analysis may be used to create sample sets for each grid, with a positive stop used where analysis shows asbestos present (eliminating the need to analyze the second sub grid).

10. Samples will be placed in a sample jar, labeled, and location, time, date will be documented.
11. The sample will be homogenized at the laboratory;
12. Follow proper chain of custody protocols.

### **Subsurface Soil Sampling - Borings**

1. A composite sample should be collected from each soil boring. The sample should be made up of five (5) to ten (10) aliquots representative of the soil boring. The actual number of aliquots may vary depending on the depth of sampling and the conditions observed.

### **Subsurface Soil Sampling – Potholes and Trenches**

1. Collect a composite sample made up of five (5) to ten (10) aliquots representative of the soil encountered in the trench or pothole. The actual number of aliquots may vary depending on the depth of sampling and the conditions observed. In addition, it may be warranted to collect separate samples from various strata, with aliquots collected from individual strata, to better characterize observed conditions.

### **Informational Soil Samples for Imported/Exported Soil**

1. The asbestos soil inspector will collect composite samples comprised of 10-point aliquots from 10% of the total number of loads dumped (for imported soils) and/or loaded (for exported soils). Soils sampled for informational purposes shall be managed in an appropriate manner (stockpiled by day, area, etc) to allow appropriate management of soil based on soil sampling data. All soil samples will be submitted to an accredited laboratory for PLM analysis on a “rush” turnaround.

### **Interpretation of Sampling Data**

1. Samples reporting no asbestos detected shall be interpreted as non-ACS, and samples reporting the presence of asbestos shall be considered ACS.

## **ATTACHMENT #5**

### **SOP SUPPLEMENTAL PROCEDURES REMEDIATION PLAN**

Where the intent is to remediate (removal all visible debris and asbestos in soil to a concentration of no asbestos detected in the soil, based on soil sampling), the following supplement to the SOP provides specific remediation provisions.

The following provisions identified in Section 12 of the SOP shall apply to ACS surface soil remediation (soil removal, packaging, transportation and disposal) procedures:

- Notifications Planned Asbestos-contaminated Soil Disturbance
- Limited Quantity Discovery Management and Disposal
- Site Control, Demarcation, Fencing and Wind Screening
- Protection of Adjacent Structures
- Soil Wetting and Stabilization
- Dust and Emissions Control
- PPE
- Equipment/Engineering Controls
- Removal/Excavation
- Soil Stockpiling
- Wind and Work Stoppage Conditions
- Environmental Monitoring
- Personal Air Monitoring
- Truck/Container Staging/Lining and Waste Loading
- Waste Transportation and Disposal
- Personnel Decontamination
- Equipment Decontamination
- Final Inspection Procedures

All ACS identified based on visual characterization (extent and depth) of find, shall be removed plus an additional 12 inches of soil beyond the extent of find (EOF) and 12 additional inches beyond the depth of find (DOF) which identifies the 3-dimension box of soil removed under the remediation.

After removal to EOF and DOF based on visual and preliminary soil sampling data, post remediation “surface clearance” soil sampling will be conducted in accordance with the Soil Sampling and Analysis Plan (Attachment #4) of this SOP, on a grid by grid basis. Any grid reporting the presence of asbestos will be considered to have “failed” and will require removal of additional twelve (12) inches of soil, and the “clearance process will be repeated until “no asbestos detected” is reported for that grid, after which that grid will then have deemed to “pass”. Once all grids in the delineated area have been characterized, remediated, and passed “clearance soil testing”, the remediation action will be considered complete

**ATTACHMENT #6**

**CDPHE HMWMD NOTIFICATION SUMMARY AND  
NOTIFICATION FORMS**

## STATE OF COLORADO

Bill Ritter, Jr., Governor  
Martha E. Rudolph, Executive Director

Dedicated to protecting and improving the health and environment of the people of Colorado

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Laboratory Services Division  
8100 Lowry Blvd.  
Denver, Colorado 80230-6928  
(303) 692-3090



Colorado Department  
of Public Health  
and Environment

April 28, 2010

Mr. Ken Neeper  
Manager Infrastructure Development  
University of Colorado Denver  
Mail Stop F418  
1945 North Wheeling Street  
Aurora, CO 80045

RE: Asbestos-Contaminated Soil (ASC) Management, Standard Operating Procedure (SOP) Document,  
University of Colorado Denver Anschutz Medical Campus, February 26, 2010

Dear Mr. Neeper,

The Colorado Department of Public Health and Environment, Hazardous Materials and Waste Management Division (the "Division"), has received and reviewed the above referenced standard operating procedures for the proper management of asbestos-contaminated soils during soil disturbing activities at the Anschutz Medical Campus of the University of Colorado Denver. The Anschutz Medical Campus is located on the site of the former Fitzsimons Army medical Center in Aurora, Colorado. The Division has no additional comments and hereby approves the Anschutz Medical Campus ACS Management SOP Document.

If you have any further questions or comments please contact me at 303-692-3416 or via e-mail at [jeffrey.swanson@state.co.us](mailto:jeffrey.swanson@state.co.us).

Sincerely,

Jeffrey R. Swanson, P.E.  
Federal Facilities Restoration and Reuse Unit  
Remedial Program

CC: Tom Butts, Walsh Environmental Scientists and Engineers  
Monica Sheets, CDPHE  
Rob Eber, AGO  
File Copy: RD007-13.1

END OF SECTION 02 81 00

## **SECTION 03 30 00 -CAST-IN-PLACE CONCRETE**

### **PART 1 - PART 1 - GENERAL**

#### **1.1 SYSTEM REQUIREMENTS**

- A. Design Requirements:
  - 1. Concrete mixtures for concrete slabs and concrete deck fill shall be normal weight and shall have a water-cement ratio of 0.45 or less.
  - 2. Provide sheet vapor retarder directly below concrete at all slabs-on-grade.

### **PART 2 - PRODUCTS**

#### **2.1 MATERIALS**

- A. Concrete Materials:
  - 1. Portland Cement Replacement: Fly ash to reduce portland cement up to 40 percent is acceptable for concrete mixtures for footings, foundation walls, walls, columns, and other vertical surfaces; not permitted for slabs.
- B. Sheet Vapor Retarder: ASTM E 1745, Class A, 15 mil, except with maximum perm rating of 0.01. Include manufacturer's recommended adhesive or pressure-sensitive tape. Provide at all slabs-on-grade.
- C. Penetrating Liquid Floor Treatments: Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces. Provide at loading docks, receiving areas, and other similar exposed concrete floor surfaces subject to heavy, hard-wheeled devices.
- D. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Floor and Slab Finishes:
  - 1. Trowel: Surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or thin-film-finish coating system.
  - 2. Broom: Exterior concrete platforms, steps, and ramps.

#### **3.2 FIELD QUALITY CONTROL**

- A. Testing: By The University-engaged agency.
- B. Special Inspections: By The University-engaged special inspector.
- C. Cost of Testing: To be included as part of Project budget.

**END OF SECTION 03 30 00**

## **SECTION 06 10 53 - MISCELLANEOUS ROUGH CARPENTRY**

### **PART 1 - GENERAL**

#### **1.1 SYSTEM REQUIREMENTS**

- A. Design Requirements
  - 1. Wood studs not permitted. If required and approved by the University Project Manager provide fire-retardant-treated lumber.
  - 2. Select composite wood products with low emissions based on ASTM testing standards E1333-10.

### **PART 2 - PRODUCTS**

#### **2.1 MATERIALS**

- A. Wood Products, General:
  - 1. Maximum Moisture Content of Lumber: 15 percent for 2-inch nominal thickness or less, 19 percent for more than 2-inch nominal thickness.
- B. Wood-Preservative-Treated Materials:
  - 1. Preservative Treatment: AWPAC U1; use Category UC2 except use Category UC3b for exterior construction and use Category UC4a for items in contact with the ground.
    - a. Preservative Chemicals: Containing no arsenic or chromium.
  - 2. Application: Items indicated and the following:
    - a. Items in contact with roofing or waterproofing.
    - b. Items in contact with concrete or masonry.
    - c. Framing less than 18 inches above ground in crawlspaces.
    - d. Floor plates installed over concrete slabs-on-grade.
- C. Fire-Retardant-Treated Materials:
  - 1. Exterior type for exterior locations and where indicated.
  - 2. Interior Type A, High Temperature (HT) for enclosed roof framing and where indicated.
  - 3. Interior Type A unless otherwise indicated.
  - 4. Application: All miscellaneous carpentry.
- D. Miscellaneous Lumber:
  - 1. Dimension Lumber: Construction or No. 2 grade any species.
- E. Plywood Backing Panels: Exterior, AC, fire-retardant treated.
- F. Fasteners: Hot-dip galvanized steel where exposed to weather, in ground contact, in contact with treated wood, or in area of high relative humidity.

### **PART 3 - EXECUTION (Not Applicable)**

**END OF SECTION 06 10 53**

## **SECTION 06 40 23 - INTERIOR ARCHITECTURAL WOODWORK**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Plastic-laminate cabinets.
- B. Related Sections include the following:
  - 1. Division 06 Section "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing woodwork and concealed within other construction before woodwork installation.
  - 2. Division 06 Section "Finish Carpentry" for interior carpentry exposed to view that is not specified in this Section.

#### **1.3 DEFINITIONS**

- A. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips for installing woodwork items unless concealed within other construction before woodwork installation.

#### **1.4 QUALITY ASSURANCE**

- A. Installer Qualifications: Certified participant in AWI's Quality Certification Program.
- B. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.
  - 1. Provide AWI Quality Certification Program labels and certificates indicating that woodwork complies with requirements of grades specified.

#### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

#### **1.6 PROJECT CONDITIONS**



- A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
  - 1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.
  - 2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

## 1.7 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.

## PART 2 - PRODUCTS

### 2.1 WOODWORK FABRICATORS

- A. Fabricators: Subject to compliance with requirements, provide interior architectural woodwork by one of the following:

### 2.2 MATERIALS

- A. General: Provide materials that comply with requirements of AWI's quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.
- B. Wood Species and Cut for Transparent Finish: Red oak, plain sawn or sliced.
- C. Wood Products: Comply with the following:
  - 1. Medium-Density Fiberboard: ANSI A208.2, Grade MD.
  - 2. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.
  - 3. Softwood Plywood: DOC PS 1, Medium Density Overlay.
- D. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.
  - 1. Provide PVC or polyester edge banding complying with LMA EDG-1 on components with exposed or semiexposed edges.
- E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.

1. Manufacturer: Subject to compliance with requirements, provide high-pressure decorative laminates by one of the following:
    - a. Formica Corporation.
    - b. Lamin-Art, Inc.
    - c. Nevamar Company, LLC; Decorative Products Div.
    - d. Wilsonart International; Div. of Premark International, Inc.
  2. Colors and Patterns: As selected by Architect from manufacturer's full range.
- F. Cabinets: Provide cabinets manufactured by a single manufacturer.

## 2.3 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets, except for items specified in Division 08 Section "Door Hardware (Scheduled by Describing Products)."
- B. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
  1. Satin Stainless Steel: BHMA 630.
- C. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

## 2.4 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.
- C. Adhesive for Bonding Plastic Laminate: Urea formaldehyde.
  1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

## 2.5 FABRICATION, GENERAL

- A. Interior Woodwork Grade: Unless otherwise indicated, provide Premium-grade interior woodwork complying with referenced quality standard.
- B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.
- C. Fabricate woodwork to dimensions, profiles, and details indicated.
- D. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and

installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

- E. Shop-cut openings to maximum extent possible to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

- 1. Seal edges of openings in countertops with a coat of varnish.

## 2.6 PLASTIC-LAMINATE CABINETS

- A. AWI Type of Cabinet Construction: Flush overlay.

- B. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:

- 1. Horizontal Surfaces Other Than Tops: Grade HGS.
  - 2. Postformed Surfaces: Grade HGP.
  - 3. Vertical Surfaces: Grade HGS.
  - 4. Edges: PVC edge banding, 0.12 inch (3 mm) thick, matching laminate in color, pattern, and finish.

- C. Materials for Semiexposed Surfaces:

- 1. Surfaces Other Than Drawer Bodies: Thermoset decorative panels.
    - a. Edges of Plastic-Laminate Shelves: PVC edge banding, 0.12 inch (3 mm) thick, matching laminate in color, pattern, and finish.
    - b. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, Grade CLS.
  - 2. Drawer Sides and Backs: Thermoset decorative panels.
  - 3. Drawer Bottoms: Hardwood plywood.

- D. Concealed Backs of Panels with Exposed Plastic Laminate Surfaces: High-pressure decorative laminate, Grade BKL.

- E. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

- 1. As indicated by laminate manufacturer's designations.
  - 2. Match Architect's sample.
  - 3. As selected by Architect from laminate manufacturer's full range in the following categories:
    - a. Solid colors, matte finish.
    - b. Solid colors with core same color as surface, matte finish.
    - c. Wood grains, matte finish.
    - d. Patterns, matte finish.

- F. Provide dust panels of 1/4-inch (6.4-mm) plywood or tempered hardboard above compartments and drawers, unless located directly under tops.

## 2.7 PLASTIC-LAMINATE CABINET CONSTRUCTION

- A. All particleboard shall be 45 Lbs. per cubic foot.
  - B. Sub-tops and bottoms: Sub-tops and bottoms of cabinets shall be particle board 3/4" thick. Bottom shall be laminated on the interior with melamine laminate with a backer sheet on the unexposed surface. The bottom surface of upper cabinets shall be laminate cabinet liner.
  - C. Cabinet Ends: Cabinet ends shall be particleboard, 3/4" thick. Concealed exterior with a melamine backer sheet. Exposed cabinets ends shall be laminated with vertical grade decorative plastic; laminate .030 inch thick. Holes shall be drilled for interior adjustable shelf clips.
  - D. Cabinet Back: Standard. recessed cabinet back shall be 1/4 inch thick prefinished hardboard glued into cabinets. Laminate to match cabinet interior. All sink cabinets shall have split back, removable from inside. Exposed exterior back on fixed cabinets shall be particleboard, 3/4" thick laminated with high pressure, vertical grade, .030" thick, High Pressure Decorative Laminate.
  - E. Cabinet Doors and Drawer Fronts: Particleboard, 3/4" thick, shall be laminated with vertical grade decorative plastic laminate on the exposed surface and melamine laminate cabinet liner on the interior surface.
  - F. Drawers: Sides, back and sub-fronts shall be particle board, 1/2" thick, laminated with melamine laminate. The back and sub-front shall be doweled and glued into the sides. No staples or nails permitted. Drawer bottom to be 1/4" thick, Prefinished hardboard let into sub-front, sides and back. Paper storage drawers shall be heavy-duty 3/4" particleboard construction with 100 pound full extension slides, plywood reinforcement stiffener at bottom and a retaining hood at the rear of each drawer.
  - G. Vertical Dividers: Particleboard 3/4" thick, shall be laminated with melamine laminate cabinet liner, both sides.
  - H. Fixed Intermediate and Adjustable Shelves: Particle board, 3/4" thick, laminated on both sides with melamine laminate cabinet liner (closed door cabinets). Adjustable shelves up to 30 inches wide shall be 3/4" thick. Shelves 30" to 36" wide shall be 1" thick. Casework units wider than 36" shall have vertical dividers. Open shelf unit cabinet shelves shall be laminated with vertical grade, .030" thick, plastic laminate.
  - I. Maximum span for wood or plastic laminate covered shelves is 36" between shelf standards.
  - J. Acceptable joinery/construction: Tops and bottoms shall be joined to cabinet ends using a minimum of six (6) dowels for twenty-four (24) inch deep cabinets and a minimum for four (4) dowels for twelve (12) inch deep cabinets. All dowels shall be hardwood laterally fluted, with chamfered end. Internal cabinet components such as fixed horizontals, rails, and vertical shall be doweled in place. Dowels shall be securely glued and cabinets clamped under pressure during assembly to assure secure joints and cabinet squareness.
- 2.8 PLASTIC-LAMINATE CABINET HARDWARE AND ACCESSORIES:
- A. Hinges: 5 knuckle 2-3/4", recessed in box wall type; .095" thick steel with metallic finish. Hinges shall have a minimum of 8 leaf and edge fastening locations. Doors 48" and over in height shall have three (3) hinges per door.
  - B. Door and Drawer Pulls: Epoxy powder coat on metallic finish metal wire pulls.
  - C. Drawer Suspensions: Each drawer equipped with one pair of ball bearing nylon roller suspensions which shall be self-closing from a four (4) inch extension, have a minimum load capacity of one hundred (100) pounds and be of zinc coated rolled steel. Knee space drawers shall be equipped with suspensions with a

minimum load capacity of fifty (50) pounds each. Heavy-duty paper storage and file drawers shall be equipped with full extension suspensions with a minimum load capacity of one hundred fifty (150) pounds each and 200 pound capacity at full extension lateral file drawers.

- D. Drawer Stops: Drawers shall be equipped with two (2) drawer stops attached to the cabinet ends. The cabinet drawer stops shall be metal with attached rubber bump and be installed to prevent the drawer face from touching the cabinet body when the drawer is in a closed position.
- E. Door Catches: Magnetic type with a minimum ten (10) pound pull, attached with screws and slotted for adjustment. Provide thumb latch on inactive leaf on pairs of doors.
- F. Shelf Supports: Heavy-duty, self-locking nylon or polycarbonate, designed for installation in pre-drilled holes in cabinet ends and vertical partitions. Supports shall carry up to 1,500 pounds without failure.
- G. Door and Drawer Locks: Five (5) disc tumbler, cam type, keyed alike or differently and master keyed as directed by School District. Each different lock shall be furnished with two (2) keys. Fifty (50) lock changes available. All drawers and doors to have locks.
- H. Chain Bolts: 3 inches long, with 18" pull and angle strike to secure inactive door on cabinets over 72" in height. Elbow catches shall be used on inactive doors up to and including 72" in height.
- I. Tote Trays: Heavy-duty vacuum formed plastic type with top rim and pull. Each tray shall be tan or ivory in color and equipped with a plated steel label holder.
- J. Index Followers: Steel plate and rod file followers recessed in bottom of file drawers.
- K. Conduit sleeves: Provide plastic grommets in tops of work stations.

### PART 3 - EXECUTION

#### 3.1 PREPARATION

- A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas.
- B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

#### 3.2 INSTALLATION

- A. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.
- B. Assemble woodwork and complete fabrication at Project site to comply with requirements for fabrication in Part 2, to extent that it was not completed in the shop.
- C. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).
- D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine

finishing nails[ or finishing screws] for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.

- F. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
  - 1. Install cabinets with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.
  - 2. Align adjacent solid-surfacing-material countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
  - 3. Install countertops with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.
  - 4. Calk space between backsplash and wall with sealant specified in Division 07 Section "Joint Sealants."
- G. Touch up finishing work specified in this Section after installation of woodwork. Fill nail holes with matching filler where exposed.

### 3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean woodwork on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

**END OF SECTION 06 40 23**

## **SECTION 07 10 00 - DAMPROOFING AND WATERPROOFING**

### **PART 1 - GENERAL**

#### **1.1 SYSTEM REQUIREMENTS**

- A. Damproof all footings, stem walls and grade beams.
- B. Waterproof all basement level foundation walls.
  - 1. Hot fluid-applied rubberized asphalt waterproofing preferred; self-adhering modified bituminous sheet waterproofing acceptable.
  - 2. Provide HDPE sheet waterproofing at blind-side applications; bentonite panel waterproofing not acceptable.
- C. Waterproof all below grade tunnel roofs and all plazas decks over occupied space with hot fluid-applied rubberized asphalt waterproofing.
- D. Provide board insulation and protection course at all foundation walls.

### **PART 2 - PRODUCTS**

#### **2.1 DAMPROOFING**

- A. Cold-applied, emulsified-asphalt dampproofing.

#### **2.2 SELF-ADHERING MODIFIED BITUMINOUS SHEET WATERPROOFING**

- A. Modified Bituminous Sheet: Minimum 60-mil nominal thickness, self-adhering sheet consisting of 56 mils of rubberized asphalt laminated on one side to a 4-mil- thick, polyethylene-film reinforcement, and with release liner on adhesive side
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. American Hydrotech, Inc. VM75.
    - b. Grace, W.R., & Co.; Bituthene 3000/Low Temperature or Bituthene 4000.
    - c. Meadows, W.R., Inc.; SealTight Mel-Rol.

#### **2.3 HOT FLUID-APPLIED RUBBERIZED ASPHALT WATERPROOFING**

- A. Hot Fluid-Applied, Rubberized-Asphalt, Reinforced Waterproofing Membrane: Single component; 100 percent solids; hot fluid-applied, rubberized asphalt.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. American Hydrotech, Inc.; Monolithic Membrane 6125.
    - b. Tremco Incorporated; Tremproof 6100.
  - 2. Reinforced Membrane: 215 mils thick.

#### **2.4 BONDED HDPE SHEET WATERPROOFING**

- A. Bonded HDPE Sheet for Vertical Applications: Uniform, flexible, multilayered-composite sheet membrane consisting of either a HDPE film coated with a pressure-sensitive adhesive and protective release liner, total 32-mil thickness.
  - 1. Basis-of-Design Product: Subject to conformance with requirements, provide W.R. Grace & Co. Preprufe 160R or comparable product.

- B. Bonded HDPE for Horizontal Applications: Uniform, flexible, multilayered-composite sheet membrane consisting of an HDPE film coated with pressure-sensitive adhesive and protective release liner, total 46-mil thickness.
  - 1. Basis-of-Design Product: Subject to conformance with requirements, provide W.R. Grace & Co. Preprufe 300R or comparable product.

## 2.5 MOLDED-SHEET DRAINAGE PANELS

- A. Nonwoven-Geotextile-Faced, Molded-Sheet Drainage Panel: Composite subsurface drainage panel consisting of a studded, nonbiodegradable, molded-plastic-sheet drainage core; with a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding No. 70 sieve laminated to one side of the core and a polymeric film bonded to the other side; and with a vertical flow rate of 9 to 15 gpm per ft.

## 2.6 INSULATION

- A. Board Insulation: Extruded-polystyrene board insulation complying with ASTM C 578, Type IV, 25-psi minimum compressive strength; square or shiplap edged.

## PART 3 - EXECUTION (Not Applicable)

**END OF SECTION 07 10 00**



## **SECTION 07 21 00 - THERMAL INSULATION**

### **PART 1 - GENERAL**

#### **1.1 SYSTEM REQUIREMENTS**

- A. Design Requirements:
  - 1. R-value of roofs, walls, and floors shall be not less than the prescriptive requirements of ASHRAE 90.1, latest edition. Lower R-values are not permitted even if International Energy Code Compliance can be demonstrated using the energy model approach.
  - 2. Wherever possible continuous insulation is encouraged.
  - 3. Provide WUFI moisture analysis of all exterior wall and roof assemblies to determine and justify the appropriate placement of a vapor retarder within the assembly.

### **PART 2 - PRODUCTS**

#### **2.1 MATERIALS**

- A. Insulation:
  - 1. Extruded-Polystyrene Board: Type IV, 25 psi.
  - 2. Foil-Faced, Mineral-Wool Board: 4 lb/cu. ft.
  - 3. Unfaced Glass-Fiber Blanket: Type I.
  - 4. Closed-Cell Spray Polyurethane Foam: Type II, minimum density of 1.5 lb/cu. ft.
- B. Vapor Retarders: Reinforced polyethylene.

### **PART 3 - EXECUTION (Not Applicable)**

**END OF SECTION 07 21 00**

**SECTION 07 62 00 - SHEET METAL FLASHING AND TRIM**

**PART 1 - GENERAL**

**1.1 SYSTEM REQUIREMENTS**

- A. Design Requirements:
  - 1. Comply with SMACNA's "Architectural Sheet Metal Manual".
  - 2. Provide two lines of butyl sealant at all flashing and equipment base lap joints to maintain weatherproof seal.
- B. PERFORMANCE REQUIREMENTS
  - 1. Roof Edge Flashing and Copings: Capable of resisting Wind Zone 3 forces according to FMG Loss Prevention Data Sheet 1-49.

**PART 2 - PRODUCTS**

**2.1 MATERIALS**

- A. Sheet Metals:
  - 1. Aluminum Sheet with Smooth, Flat Surface:
    - a. Coil-Coated Finish: Three-coat fluoropolymer.
    - b. Use: For all exposed to view locations.
  - 2. Stainless-Steel Sheet: 2D (dull, cold rolled) finish with surface.
    - a. Use: For all concealed from view locations.
- B. Underlayment: Self-adhering, high-temperature sheet.

**PART 3 - EXECUTION (Not Applicable)**

**END OF SECTION 07 62 00**

## SECTION 07 92 00 - JOINT SEALANTS

### PART 1 - GENERAL

- 1.1 EXTENDED WARRANTY: Provide a written two-year warranty, signed by Contractor and sealant installer, guaranteeing all exterior joints and interior joints for a period of not less than two (2) years from date of the Letter of Acceptance of the Work by the College.

### 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.
  - 2. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dow Corning Corporation; 790.
    - b. GE Advanced Materials - Silicones; SilPruf LM SCS2700.
    - c. Tremco Incorporated; Spectrem 1.
- B. Single-Component, Pourable, Traffic-Grade, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade P, Class 100/50, for Use T.
  - 1. Use: For joints in horizontal traffic surfaces.
  - 2. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dow Corning Corporation; 890-SL.
    - b. Pecora Corporation; 300 SL.
    - c. Tremco Incorporated; Spectrem 900 SL.
- C. Mildew-Resistant, Single-Component, Acid-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.
  - 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.
  - 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.
- D. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
  - 1. Use: For interior door frames and other static joints.
  - 2. Products: Subject to compliance with requirements, provide one of the following:
    - a. BASF Building Systems; Sonolac.
    - b. Bostik, Inc.; Chem-Calk 600.
    - c. Pecora Corporation; AC-20+.
    - d. Tremco Incorporated; Tremflex 834.
- E. Acoustical Joint Sealant: Nonsag, paintable, nonstaining latex.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Pecora Corporation; AC-20 FTR.
    - b. USG Corporation; SHEETROCK Acoustical Sealant.

- F. Cylindrical Joint-Sealant Backing: ASTM C 1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- 1. Per Manufacturers written instructions.

**END OF SECTION 07 92 00**

## **SECTION 08 00 00 - OPENINGS**

### **PART 1 - GENERAL**

#### **1.1 SYSTEM REQUIREMENTS**

- A. Design Requirements:
  - 1. Design doors to be larger than the width of the largest piece of equipment to be installed in the space.
  - 2. Provide either hollow metal or glazed aluminum storefront for all exterior doors; wood doors not permitted.
  - 3. Provide either hollow metal or solid-core wood for interior doors.
  - 4. Provide 3'-0" by 7'-0" doors typical; wider doors are permitted if required by function and approved by the University Project Manager.
  - 5. Prepare doors and frames to receive security hardware including door switch monitoring devices. Refer to 28 13 00 – Access Control.
  - 6. All replacement windows must be approved by the University Campus Architect and the University Project Manager.
  - 7. Provide solid doors for vermin control at all OLAR doors.
  - 8. All-glass doors are prohibited for interior use. Provide wood stile and rail doors with glass.

### **PART 2 - PRODUCTS**

#### **2.1 MATERIALS**

- A. Doors:
  - 1. Provide all fire-rated doors and frames with an approved UL label.

### **PART 3 - EXECUTION (Not Applicable)**

**END OF SECTION 08 00 00**

## SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES

### PART 1 - GENERAL (Not Applicable)

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products from one of the following:
  - 1. Ceco Door Products; an Assa Abloy Group company.
  - 2. Curries Company; an Assa Abloy Group company.
  - 3. Republic Doors and Frames.
  - 4. Steelcraft; an Ingersoll-Rand company.
  - 5. Any current member in good standing of the Steel Door Institute (SDI).

#### 2.2 INTERIOR DOORS AND FRAMES

- A. SDI Extra Heavy Duty: ANSI/SDI A250.8, Level 3. Uncoated, cold-rolled steel sheet.
  - 1. Edge Construction: Model 2, Seamless.
  - 2. Core: Manufacturer's standard.
  - 3. Frames: Face welded.
  - 4. Exposed Finish: Prime for field painting.

#### 2.3 EXTERIOR DOORS AND FRAMES

- A. SDI Maximum Duty: ANSI/SDI A250.8, Level 4. Metallic-coated, cold-rolled steel sheet.
  - 1. Edge Construction: Model 2, Seamless.
  - 2. Core: Manufacturer's standard, insulated.
  - 3. Frames: Face welded.
  - 4. Exposed Finish: Prime for field painting.

#### 2.4 FABRICATION

- A. Preparation for Finish Hardware:
  - 1. Doors and Frames: Spot weld all reinforcement at the factory. Drill and tap for mortise template hardware.
  - 2. Frame Reinforcement: Comply with ANSI/SDI A250.6 and the following:
    - a. Hinges: 7 gage plate, 12 inches long by full width of jamb at each hinge.
    - b. Lock: 12 gage.
    - c. Strikes, Flush Bolts, and all other Surface Mounted Hardware: 12 gage.
    - d. Closer: 10 gage channel section, 12 inches long and full width of frame trim.
  - 3. Door Reinforcement: Comply with ANSI/SDI A250.6 and the following:
    - a. Hinges: 7 gage, 9 inch long, welded to 16 gage interior edge channels at each hinge.
    - b. Closers: 12 gage box section minimum 4 inch deep and 12 inch long.
    - c. Locksets, Deadbolts, Panic Devices: 12 gage.
    - d. Pull Plates, Flush Bolts, and Surface Mounted Hardware: 12 gage.
- B. Frame Anchors:
  - 1. Frames up to 7 feet tall: 3 anchors per jamb.
  - 2. Frames greater than 7 feet and less than 8 feet tall: 4 anchors per jamb.
  - 3. Frames greater than 8 feet tall: 1 additional anchor for each 2 feet or fraction thereof in height per jamb.

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PART 3 - EXECUTION (Not Applicable)

**END OF SECTION 08 11 13**

## SECTION 08 71 00 - DOOR HARDWARE

### PART 1 - GENERAL

#### 1.1 SYSTEM PERFORMANCE REQUIREMENTS

##### A. Design Requirements

1. Provide Mortise and Rim Cylinders capable of accepting small format (7 pin) interchangeable cores.
  - a. Dull chromium (626) finish, unless otherwise specified and approved by the University Locksmith through the University Project Manager.
2. Consult with the University Locksmith, through the University Project Manager, regarding the various lock functions and keyway for each building.
3. Provide dull chromium (626) finish durable door stops, holders, flush bolts, etc.
4. Provide backing behind doorstops.
5. Provide quality weather stripping on all exterior doors.
6. Computer operated proximity card access systems are allowed. Coordinate design with the University Project Manager.
7. Provide electric strikes or electric locks where required. Use of electrified hinges must be approved by the University Project Manager. Refer to 28 13 00 – Access Control for additional information.
8. Provide manual lock-down capability via locking doors or manual key override to electronic lock systems at all buildings. Egress doors must maintain all required egress characteristics.
9. Concealed rods are not permitted.
10. Coordinate door hardware with security hardware requirements. Refer to Division 28 for additional information.
11. Coordinate all hardware and access control at the University of Colorado Denver with the University Locksmith.

##### B. Performance Requirements

1. Key interchangeable cores at factory.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

##### A. Acceptable Manufacturers:

1. Lock Sets:
  - a. University of Colorado Anschutz Medical Campus:
    - 1) Best 9K Series Heavy-Duty Lockset with 14D Lever Style Cylindrical Lever sets.
  - b. University of Colorado Denver:
    - 1) Schlage Falcon T Series with quantum lever 626 satin chrome finish and Schlage interchangeable everest B core
2. Automatic Door Opener:
  - a. Stanley Magic Door, Magic Swing Micro (preferred)
  - b. Dorma ED800
3. Closers:
  - a. LCN 4041
  - b. Norton 1600 Series at storefront applications
  - c. LCN Door Closer, 1460 Series Aluminum
4. Hinges:
  - a. Hager
  - b. Stanley – FBB179
  - c. Stanley – FBB168
5. Exit Device:



- a. Von Duprin (preferred)
- 6. Key Lock Box:
  - a. Knox Company, 3200 Series

## 2.2 MATERIALS

- A. Lock Sets:
  - 1. Lock Functions: Selected by the University locksmith through the University Project Manager. Stock numbers provided by the University Locksmith from acceptable manufactures.
- B. Door Guards:
  - 1. Kickplates: Stainless steel with 626 finish.
- C. Key Lock Box
  - 1. Recessed, heavy-duty, high-security key box with hinged door. No tamper alarm.
  - 2. Color: As determined by design team.
  - 3. Coordinate location with the University Fire and Life Safety Officer.
  - 4. Mounting Height: 5 feet above finished surface.

## PART 3 - EXECUTION (Not Applicable)

**END OF SECTION 08 71 00**

## **SECTION 09 00 00 - FINISHES**

### **PART 1 - GENERAL**

#### **1.1 SYSTEM REQUIREMENTS**

- A. Design Requirements:
  - 1. Interior design color palette proposed by the Design Professional must meet all criteria established with input and approval by the University Campus Architect through the University Project Manager.
  - 2. Provide rubber base at both carpet and resilient flooring installations. Upgrades are permissible with approval of the University Campus Architect through the University Denver Project Manager.
  - 3. All penetrations and/or seams in materials in BSL3, Vivaria, and other similar functional areas are to be sealed, unless otherwise noted.
- B. Performance Requirements:
  - 1. Fire-Test-Response Characteristics:
    - a. Surface-Burning Characteristics: As determined by testing per ASTM E 84.
      - 1) Flame-Spread Index: 25 or less.
      - 2) Smoke-Developed Index: 25 or less.
      - 3) Fuel Contributed Index: 15 or less.

### **PART 2 - PRODUCTS (Not Applicable)**

### **PART 3 - EXECUTION**

#### **3.1 PREPARATION OF CONCRETE TO RECEIVE MOISTURE SENSITIVE FLOORING**

- A. Prepare all concrete substrates to receive moisture sensitive floor finishes including, but not limited to, resilient sheet floor, linoleum flooring, resilient tile flooring, resinous matrix terrazzo flooring, resinous flooring, sheet carpeting and tile carpeting, according to ASTM F 710 and the following:
  - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
  - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
  - 3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrate pH is between 7.0 and 9.0.
  - 4. Moisture Testing: Perform tests recommended by manufacturer and as follows. Proceed with installation only after substrates pass testing.
    - a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
    - b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 80 percent relative humidity level measurement.
- B. Provide moisture vapor emissions and alkalinity control system to all concrete substrates that fail alkalinity and/or moisture testing.

**END OF SECTION 09 00 00**

## **SECTION 09 22 16 - NON-STRUCTURAL METAL FRAMING**

### **PART 1 - GENERAL**

#### **1.1 SYSTEM REQUIREMENTS**

- A. Design Requirements:
  - 1. Space studs at 16 inches on center maximum.
  - 2. Where interior partitions do not extend to the underside of structure, extend partition 6" above the ceiling grid and brace to structure at 4 feet on center. .
- B. Performance Requirements:
  - 1. Partitions, General: Provide metal framing systems of base-metal thickness and spacing capable of limiting lateral deflections when subjected to a 5 psf uniform lateral load to the following:
    - a. L/240 where supporting gypsum board only.
    - b. L/360 where supporting plaster or ceramic tile finishes.
    - c. L/720 where providing backup to stone or masonry.
  - 2. Partitions Enclosing Pressurized Mechanical Rooms: Provide metal framing systems of base-metal thickness and spacing capable of limiting lateral deflections to L/240 when subjected to a 15 psf uniform lateral load or the design value induced by the mechanical system, whichever is greater.
  - 3. Suspended Ceiling Design Requirements: Provide metal framing systems of base-metal thickness and spacing capable of limiting ceiling deflections to L/360 when subjected to a minimum 4 psf uniform load or the actual weight of ceiling hung materials, whichever is greater.
  - 4. Engineering design of non-structural metal framing by Contractor.

### **PART 2 - PRODUCTS**

#### **2.1 MATERIALS**

- A. Steel Framing for Framed Assemblies:
  - 1. Steel studs and runners: 0.033-inch-thick (20 gauge) minimum.
  - 2. Dimpled steel studs and runners: 0.025-inch-thick minimum, with structural properties equivalent to 0.0329-inch-thick steel studs.

### **PART 3 - EXECUTION (Not Applicable)**

#### **3.1 INSTALLATION**

- A. Secure with fasteners or proper crimping tools; do not weld.

**END OF SECTION 09 22 16**

## **SECTION 09 29 00 - GYPSUM BOARD**

### **PART 1 - GENERAL**

#### **1.1 SYSTEM REQUIREMENTS**

- A. Design Requirements
  - 1. Design all walls within a vivarium to have a sound transmission class (STC) rating of 55 or better.

### **PART 2 - PRODUCTS**

#### **2.1 MATERIALS**

- A. Interior Gypsum Board:
  - 1. Gypsum board, Type X: Provide 5/8 inch thick, typical unless noted otherwise.
  - 2. Abuse-resistant gypsum board: Provide at service corridors.
  - 3. Moisture- and mold-resistant gypsum board. Provide at all high humidity areas.
- B. Exterior Gypsum Board for Ceilings and Soffits:
  - 1. Glass-mat gypsum sheathing board.
- C. Tile-Backing Panels:
  - 1. Glass-mat, water-resistant backing board.
- D. Trim Accessories:
  - 1. Interior: Paper-faced galvanized steel sheet.
  - 2. Exterior: Hot-dipped galvanized steel sheet or rolled zinc.
- E. Auxiliary Materials
  - 1. Sound attenuation blankets.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Finishing Gypsum Board Assemblies:
  - 1. Levels of Gypsum Board Finish: At a minimum, comply with recommendations in GA-214, "Recommended Levels of Gypsum Board Finish."

**END OF SECTION 09 29 00**

## SECTION 09 30 00 - TILING

### PART 1 - GENERAL

#### 1.1 SYSTEM REQUIREMENTS

- A. Design Requirements:
  - 1. Provide tile selection as approved by the University Campus Architect through the University Project Manager.
  - 2. Provide waterproof membrane under all tile installations above occupied space.

### PART 2 - PRODUCTS

#### 2.1 TILE PRODUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. American Olean; Division of Dal-Tile International Inc.
  - 2. Daltile; Division of Dal-Tile International Inc.
  - 3. United States Ceramic Tile; a Roca Tile Group company.
- B. Other Tile: Only as approved by the University Campus Architect through the University Project Manager.
- C. Trim Shapes:
  - 1. Wainscot cap: Surface bullnose.
  - 2. Base: Coved base.
  - 3. Outside Corners: Surface bullnose.
  - 4. Inside Corners:
  - 5. Jambs: Surface bullnose where tile projects from jamb.

#### 2.2 ACCESSORY MATERIALS

- A. Thresholds: Stone.
- B. Waterproof Membrane: Chlorinated polyethylene sheet; fluid applied membranes are not permitted.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide The Noble Company, NobleSeal TS or comparable product.
- C. Crack Isolation Membrane: Chlorinated polyethylene sheet.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide The Noble Company, NobleSeal CIS or comparable product.
- D. Metal base and edge strips: Where tile trim shapes are not available use metal accessories:
  - 1. Coved Metal Base: Subject to compliance with requirements, provide Schluter-DILEX-EHK or comparable product.
  - 2. Coved Metal Inside Corner: Subject to compliance with requirements, provide Schluter-DILEX-EHK or comparable product.
  - 3. Edge Protection: Subject to compliance with requirements, provide Schluter-SCHIENE or comparable product.
  - 4. Outside Corner: Subject to compliance with requirements, provide Schluter-QUADEC or comparable product.
  - 5. Wainscot Cap: Subject to compliance with requirements, provide Schluter-JOLLY, Schluter-QUADEC or comparable product.

6. Transition Strips: As required where adjacent floor finish is of different thickness.

## PART 3 - EXECUTION

### 3.1 INTERIOR TILE INSTALLATION SCHEDULE

- A. Interior Floors on Concrete:
  1. TCNA F113: Thin-set mortar.
    - a. Mortar: Latex-portland cement mortar.
    - b. Grout: Polymer-modified.
  2. TCNA F122: Thin-set mortar on waterproof membrane.
    - a. Mortar: Latex-portland cement mortar.
    - b. Grout: Polymer-modified.
  3. TCNA F125A: Thin-set mortar on crack isolation membrane.
    - a. Mortar: Latex-portland cement mortar.
    - b. Grout: Polymer-modified.
- B. Interior Walls, Masonry or Concrete:
  1. TCNA W202: Thin-set mortar.
    - a. Mortar: Latex-portland cement mortar.
    - b. Grout: Polymer-modified.
- C. Interior Walls, Metal Studs or Furring:
  1. TCNA W245: Thin-set mortar on coated glass-mat, water-resistant gypsum backer board.
    - a. Mortar: Latex-portland cement mortar.
    - b. Grout: Polymer-modified.
- D. Shower Receptor and Walls, Concrete or Masonry:
  1. TCNA B421: Thin-set mortar on waterproof membrane.
    - a. Mortar: Latex-portland cement mortar.
    - b. Grout: Polymer-modified.
- E. Shower Receptor and Walls, Metal Studs or Furring:
  1. TCNA B420: Thin-set mortar on coated glass-mat, water-resistant backer board.
    - a. Mortar: Latex-portland cement mortar.
    - b. Grout: Polymer-modified.

**END OF SECTION 09 30 00**

## SECTION 09 65 00 - RESILIENT FLOORING

### PART 1 - GENERAL (Not Applicable)

### PART 2 - PRODUCTS

#### 2.1 RESILIENT BASE AND ACCESSORIES

- A. Resilient Base:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Johnsonite.
    - b. Musson, R.C. Rubber Co.
    - c. Roppe Corporation, USA.
  - 2. Material Requirement: Rubber.
  - 3. Style: Cove at all locations.
  - 4. Minimum Thickness: 0.125 inch.
  - 5. Height: 4 inches.
  - 6. Lengths: Coils in manufacturer's standard lengths.
  - 7. Outside Corners: Preformed.
  - 8. Inside Corners: Preformed.
- B. Resilient Molding Accessory: Rubber.
  - 1. Edge Strips: 0.125 inch thick, 1 inch wide, with tapered or bullnose edge.
- C. Abrasive Strips: Self-adhesive, 1 inch wide, with aluminum oxide grit.

#### 2.2 RESILIENT TILE

- A. Vinyl Composition Floor Tile:
  - 1. Class: Through pattern.
  - 2. Wearing Surface: Smooth.
  - 3. Thickness: 0.125 inch.
  - 4. Size: 12 by 12 inches.

#### 2.3 RESILIENT SHEET FLOORING

- A. Vinyl Sheet Floor Covering: ASTM F 1303, Type I, Grade 1, with Class B backing.
  - 1. Thickness: 0.080 inch thick.
  - 2. Wearing Surface: Smooth.
  - 3. Sheet Width: As standard with manufacturer.
  - 1. Seaming Method: Heat welded at medical labs (BSL2); standard otherwise.
- B. Linoleum Floor Coverings:
  - 1. Sheet Flooring: In manufacturer's standard length by not less than 78 inches wide.
  - 2. Seaming Method: Heat welded at medical labs (BSL2); standard otherwise.
  - 3. Thickness: 0.08 inch.

#### 2.4 INSTALLATION MATERIALS

- 1. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based provided or approved by manufacturer for applications indicated and capable of taper to feather edge.
- 2. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

3. Floor Polish: Provide stripper, sealer and polish recommended by the University Environmental Health and Safety (EHS) through the University Project Manager.

#### PART 3 - EXECUTION

##### 3.1 CLEANING AND PROTECTION

- A. Floor Polish: Strip factory seal and apply finish recommended by the University EHS through the University Project Manager.

**END OF SECTION 09 65 00**



## SECTION 09 91 23 - 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 metropolitan 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.

#### 1.3 QUALITY ASSURANCE

- A. MPI Standards: Provide products that comply with Master Painter Institute (MPI) standards indicated and that are listed in its "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 BLOCK FILLERS

- A. Block Filler, Acrylic/Latex, Interior/Exterior for Concrete Masonry Unit Substrates: MPI #4

#### 2.2 PRIMERS/SEALERS

- A. Primer, Alkali Resistant, Water Based, for Concrete Substrates: MPI #3
- B. Primer Sealer, Interior, Institutional Low Odor/No VOC, for Gypsum Board and Plaster Substrates: MPI #149
- C. Primer, Latex, for Interior Wood Substrates: MPI #39
- D. Wood-Knot Sealer: Sealer recommended in writing by topcoat manufacturer for use in paint systems indicated.

#### 2.3 METAL PRIMERS

- A. Primer, Rust-Inhibitive, Water Based, for Ferrous-Metal Substrates: MPI #107
- B. Primer, Galvanized, Water Based, for Zinc-Coated Metal Substrates: MPI #134
- C. Primer, Quick Dry, for Aluminum Substrates: MPI #95

## 2.4 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.
- D. Latex, Interior, Institutional Low Odor/No VOC, Semi-Gloss (Gloss Level 5): MPI #147.

## 2.5 DRY FOG/FALL COATINGS

- A. Dry Fall, Latex, Flat: MPI #118.
- B. Dry Fall, Water Based, for Galvanized Steel, Flat (Gloss Level 1): MPI #133.

## 2.6 FLOOR COATINGS

- A. Sealer, Water Based, for Concrete Floors: MPI #99.

# PART 3 - EXECUTION

## 3.1 INTERIOR PAINTING SCHEDULE

- A. Concrete Substrates, Nontraffic Surfaces: The following system is acceptable, high performance coating specified in SECTION 09 96 00 preferred.
  - 1. Institutional Low-Odor/No VOC Latex System: MPI INT 3.1M
    - a. Prime Coat: Primer sealer, interior, institutional low odor/No VOC, MPI #149.
    - b. Intermediate Coat: Latex, interior, institutional low odor/No VOC, matching topcoat.
    - c. Topcoat: Latex, interior, institutional low odor/No VOC, semi-gloss (Gloss Level 5), MPI #147.
- B. Concrete Substrates, Traffic Surfaces: At all concrete traffic surfaces scheduled to receive sealer.
  - 1. Water-Based Clear Sealer System: MPI INT 3.2G
    - a. First Coat: Sealer, water based, for concrete floors, MPI #99.
    - b. Topcoat: Sealer, water based, for concrete floors, MPI #99.
- C. CMU Substrates: The following system is acceptable, high performance coating specified in SECTION 09 96 00 preferred.
  - 1. Institutional Low-Odor/No VOC Latex System: MPI INT 4.2E
    - a. Block Filler: Block filler, latex, interior/exterior, MPI #4.
    - b. Intermediate Coat: Latex, interior, institutional low odor/No VOC, matching topcoat.
    - c. Topcoat: Latex, interior, institutional low odor/No VOC, semi-gloss (Gloss Level 5), MPI #147.
- D. Steel Substrates: At all steel substrates not indicated to receive high-performance coatings specified in SECTION 09 96 00.
  - 1. Water-Based Dry-Fall System (for overhead work only): MPI INT 5.1C
    - a. Prime Coat: Shop primer to be specified in Division 05.
    - b. Topcoat: Dry fall, latex, flat, MPI #118.
  - 2. Institutional Low-Odor/No VOC Latex System: MPI INT 5.1S
    - a. Prime Coat: Primer, rust-inhibitive, water based MPI #107.
    - b. Intermediate Coat: Latex, interior, institutional low odor/No VOC, matching topcoat.

- c. Topcoat: Latex, interior, institutional low odor/No VOC, semi-gloss (Gloss Level 5), MPI #147.
- E. Galvanized-Metal Substrates: At all galvanized metal substrates not indicated to receive high-performance coatings specified in SECTION 09 96 00.
  - 1. Water-Based Dry-Fall System (for overhead work only): MPI INT 5.3H
    - a. Prime Coat: Dry fall, water based, for galvanized steel, flat (Gloss Level 1), MPI #133.
    - b. Topcoat: Dry fall, water based, for galvanized steel, flat (Gloss Level 1), MPI #133.
  - 2. Institutional Low-Odor/No VOC Latex System: MPI INT 5.3N
    - a. Prime Coat: Primer, galvanized, water based, MPI #134.
    - b. Intermediate Coat: Latex, interior, institutional low odor/No VOC, matching topcoat.
    - c. Topcoat: Latex, interior, institutional low odor/No VOC, semi-gloss (Gloss Level 5), MPI #147.
- F. Aluminum (Not Anodized or Otherwise Coated) Substrates:
  - 1. Institutional Low-Odor/No VOC Latex System: MPI INT 5.4G
    - a. Prime Coat: Primer, quick dry, for aluminum, MPI #95.
    - b. Intermediate Coat: Latex, interior, institutional low odor/No VOC, matching topcoat.
    - c. Topcoat: Latex, interior, institutional low odor/No VOC, semi-gloss (Gloss Level 5), MPI #147.
- G. Wood Substrates:
  - 1. Institutional Low-Odor/No VOC Latex System: MPI INT 6.1Q, MPI INT 6.2L, MPI INT 6.3V, and MPI INT 6.4T
    - a. Prime Coat: Primer, latex, for interior wood, MPI #39.
    - b. Intermediate Coat: Latex, interior, institutional low odor/No VOC, matching topcoat.
    - c. Topcoat: Latex, interior, institutional low odor/No VOC, semi-gloss (Gloss Level 5), MPI #147.
- H. Gypsum Board and Plaster Substrates:
  - 1. Latex System: MPI INT 9.2A. At gypsum board, GFRG, and plaster substrates scheduled to receive gloss paint.
    - a. Prime Coat: Primer sealer, latex, interior, MPI #50.
    - b. Intermediate Coat: Latex, interior, matching topcoat.
    - c. Topcoat: Latex, interior; gloss, (Gloss Level 6, except minimum gloss of 65 units at 60 degrees), MPI #114.
  - 2. Institutional Low-Odor/No VOC Latex System: MPI INT 9.2M. At all gypsum board, GFRG, and plaster substrates, unless indicated otherwise.
    - a. Prime Coat: Primer sealer, interior, institutional low odor/No VOC, MPI #149.
    - b. Intermediate Coat: Latex, interior, institutional low odor/No VOC, matching topcoat.
    - c. Topcoat: Latex, interior, institutional low odor/No VOC; Provide one of the following as indicated in Finish Schedule:
      - 1) Flat (Gloss Level 1), MPI #143
      - 2) Egg-shell (Gloss Level 2), MPI #144 or (Gloss Level 3), MPI #145
      - 3) Semi-gloss (Gloss Level 5), MPI #147
    - d. Typical Sheen: Egg-shell (Gloss Level 2 or 3) unless indicated otherwise.

**END OF SECTION 09 91 23**

## **SECTION 10 44 00 - FIRE PROTECTION SPECIALTIES**

### **PART 1 - GENERAL**

#### **1.1 QUALITY ASSURANCE**

- A. Fire Extinguishers: Provide in accordance with NFPA 10.

### **PART 2 - PRODUCTS**

#### **2.1 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS:**

- A. Multipurpose dry-chemical type, manufacturer's standard container: 4-A:60-B:C, 10-lb.
- B. Other types: Not permitted, except if approved by the University Fire and Life Safety Officer, through the University Project Manager.

#### **2.2 FIRE PROTECTION CABINET:**

- A. Type and Size: For indicated fire extinguisher.
- B. Door Type: Solid with vertical window.
- C. Door Glazing: Acrylic sheet, glass not permitted.
- D. Accessories: Door locks not permitted unless approved by the University Fire and Life Safety Officer, through the University Project Manager.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Mounting:
  - 1. Locations: As approved by the University Fire and Life Safety Officer through the University Project Manager.
  - 2. Mounting Height: 48" to center of door handle from finished floor.
  - 3. Accessibility: Comply with accessibility requirements for both approach and reach.

**END OF SECTION 10 44 00**

## SECTION 12 36 61 - SIMULATED STONE COUNTERTOPS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Quartz agglomerate countertops.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For countertop materials.
- B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.
- C. Samples for Initial Selection: For each type of material exposed to view.

#### 1.4 PROJECT CONDITIONS

- A. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

#### 1.5 COORDINATION

- A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

### PART 2 - PRODUCTS

#### 2.1 QUARTZ AGGLOMERATE COUNTERTOPS

- A. Configuration: Provide countertops with the following front and backsplash style:
  - 1. Backsplash: Straight, slightly eased at top.
  - 2. Endsplash: None.
- B. Countertops: 1-1/4 inch-(19-mm-) thick, quartz agglomerate with front edge built up with same material.
- C. Fabrication: Fabricate tops in one piece with shop-applied edges unless otherwise indicated. Comply with quartz agglomerate manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

2.2 COUNTERTOP MATERIALS (Solid Surface 1)

- A. Quartz Agglomerate: Solid sheets consisting of quartz aggregates bound together with a matrix of filled plastic resin and complying with the "Physical Characteristics of Materials" Article of ANSI SS1.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Per Finish Schedule
  - 2. Colors and Patterns: Per Finish Schedule

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install countertops level to a tolerance of 1/8 inch in 8 feet (3 mm in 2.4 m).
- B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Pre-drill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

**END OF SECTION 12 36 61**

## SECTION 21 05 00 - FIRE SUPPRESSION

### PART 1 - GENERAL

#### 1.1 REFERENCES

- A. Section 230000 - General Mechanical Provisions
- B. Section 210553- Mechanical Identification

#### 1.2 DESIGN REQUIREMENTS

##### A. Automatic Fire Sprinklers:

1. Zone system according to location. Annunciate each zone at the building fire annunciator in accordance with NFPA regulations. Provide separate zones for each flow switch and each tamper switches.
2. Install recessed sprinklers in 8-foot ceilings. Provide wire guards on sprinklers, which protrude beyond the ceiling and are lower than 8 feet. Wire guards may be painted.
3. The type of sprinkler to be installed must be specified and approved no later than final design completion.
4. Consult the University CBO, through the University Project Manager, for fire protection and life safety concerns.
5. Supply all connections to the fire system from the domestic water system through a reduced pressure backflow prevention device.
6. Provide fire sprinkler systems for every building. Provide sprinklers throughout the building. Discuss areas without sprinklers with the University Project Manager.

##### B. System Design:

1. General:
  - a. Base design on requirements of NFPA 13, including Appendices.
  - b. Verify fire hydrant flow test according to NFPA 13 and NFPA 291. Use hydrant flow results for system design calculations.
  - c. Base design of sprinkler system on hydraulic calculations for group and occupancy listed in NFPA 13. Include outside hose flows upon the same hazard as the building. No allowance will be made for inside hose station flows. Include a safety factor of 10 psi in hydraulic calculations.
  - d. Room design method is not acceptable.
  - e. Size flow velocity in underground water mains not to exceed 16 feet per second. Size velocity in above ground sprinkler systems not to exceed 20 feet per second
  - f. Protect all areas of each facility with an automatic sprinkler system unless specifically waved by the University Project Manager.
  - g. Provide a separate zone on each floor for buildings exceeding 3 floor levels including the basement.
2. Wet Pipe Systems:
  - a. Use wet pipe systems for the majority of system applications.
  - b. Use electronic vane type water flow detectors except for the following:
    - 1) Alarm check valve assemblies may be used for systems installed in buildings if there is no approved fire alarm control panel installed and the system protects only one zone.

3. Antifreeze Systems:

- a. Do not install antifreeze systems unless specifically approved in writing by the University Project Manager.
- b. If these systems are proposed, only use them for incidental areas susceptible to freezing, as required.
- c. Determine the feasibility and advantages of using other approved methods for protection of piping against freezing.
- d. Include procedure in specifications for flow testing antifreeze systems without reducing antifreeze concentration.

1.3 SUBMITTALS

- A. Submittals for the following shall be made in accordance with Section 230000.
1. Submit sample of each type and finish of sprinkler and escutcheon plate to be installed.
  2. Submit shop drawings showing all details as defined by NFPA 13. Show pipe routing and coordination of all building components.
  3. Submit hydraulic calculations including summary sheet, detailed work sheets, graph sheet, and water supply information as outlined in NFPA 13. Designer shall seal and sign hydraulic calculations, drawings, and work sheets.
  4. Submit a copy of NFPA 25.
  5. Submit copies of Contractor's Material and Test Certificates similar to those in NFPA 13.

1.4 QUALITY ASSURANCE

- A. Design shall be performed by a NICET Level III or IV Technician, Registered Fire Protection Engineer, or Registered Professional Engineer with experience in fire protection design and registered for the design and installation for fire protection systems in the State of Colorado.
- B. Installer shall have a minimum of five years of experience in the design and installation of automatic fire sprinkler systems and employ workmen experienced and skilled in this trade.
- C. Installer shall have the capability of providing a full service maintenance, testing, and inspection program in accordance with NFPA standards and where applicable, be certified to perform these services.
- D. Installer shall have an emergency service capability for response to emergency conditions and shall be capable of responding within four hours or receiving notification with 24 hour service capability.
- E. Qualifications for Welding Processes and Operators: Comply with the requirements of AWS D10.9, Specifications of Qualifications of Welding Procedures and Welders for Piping and Tubing, Level AR-3.
- F. Regulatory Requirements: Comply with the following codes:
1. NFPA 13 - Standard for the installation of sprinkler System.
  2. FPA 14 - Standard for the Installation of Standpipe and Hose Systems.
  3. NFPA 24 - Installation of Private Fire Service Mains and their applications.
  4. NFPA 1963 - Screw threads and Gaskets for Fire Hose Connections.
  5. UL Compliance: Fire protection system materials and components shall be Underwriter's Laboratories listed and labeled for the application anticipated.
  6. National Electrical Code.
  - 7.

PART 2 - PRODUCTS

2.1 MANUFACTURERS



- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Gate Valves:
    - a. Nibco Inc.
    - b. Mueller
    - c. Grinnell
  2. Butterfly and Ball Valves:
    - a. Mueller
    - b. Victaulic
    - c. Nibco Inc.
  3. Grooved Mechanical Couplings:
    - a. Victaulic Company of America
    - b. Gruvlok
    - c. Or approved equal per Division 1 requirements.
  4. Sprinklers:
    - a. Reliable
    - b. Viking Corp.
    - c. Grinnell
  5. Fire Protection Specialties:
    - a. Croker-Standard Div.,; Fire-End & Croker Corp.
    - b. Elkhart Brass Mfg. Co., Inc.
    - c. Guardian Fire Equipment, Inc.
  6. Check Valves:
    - a. Central Sprinkler Corp.
    - b. Mueller
    - c. Viking Corp

## 2.2 MATERIALS, GENERAL

- A. Piping:
1. Black steel pipe for wet pipe systems and standpipes. Hot dipped galvanized pipe for dry pipe, pre-action and deluge systems.
  2. Schedule 40 for pipe 2-inch and smaller and joined with threaded or cut grooved fittings.
  3. Schedule 10 for pipe sizes up to 5 inch and 0.134 inches for 6 inch pipe for pipe joined by welding or roll grooved fittings.
  4. Other pipe thickness is acceptable provided the pipe UL corrosion resistance ratio (CRR) exceeds 1.00. Schedule 40 black steel has a CRR of 1.0
  5. Fittings: Provide hot dipped galvanized fittings for dry pipe, pre-action, and deluge systems. Threaded fittings are preferred in architecturally exposed or sensitive areas.
  6. Do not use Copper pipe or fittings
- B. General: Equipment shall bear the UL listing for the intended use.
- C. Valves:
1. General Requirements
    - a. Suitable for a minimum of 175 psi. working pressure unless the project requirements demand higher pressures.
    - b. Riser and Sectional Control Valves: Provide indicating type suitable for supervisory contact switch.
- D. Check Valves:
1. 1-1/2 inch and smaller: All bronze with screwed ends.
  2. 1 inch and larger: Iron or brass body.
  3. Alarm Check Valve: Same size as riser. Provide with a retarding device.

- E. Miscellaneous Valves:
  - 1. Ball Drip Valves: Brass with 1/2 inch NPT.
  - 2. Main and Sectional Drain Valves: Bronze gate valve.
  - 3. Gauge Assembly Valves: 1/4 inch globe or angle 3-way valves with screwed bonnet and renewable composition disc.
  - 4. Combination Test/Drain Valve: UL listed approved.
- F. Gauges:
  - 1. Water Pressure: Brass bourdon tube with 3-1/2 inch diameter case rated for 300 psi water pressure in 5 pound increments. Equip with 1/4-inch shut-off valve.
  - 2. Air Pressure: Brass bourdon tube with 3-1/2 inch diameter case rated for 100 psi air pressure in 1 psi increments. Equip with 1/4-inch shut-off valve.
- G. Sprinklers:
  - 1. Nominal 1/2 inch orifice for "ordinary temperature classification except where higher temperature heads are required or shown.
  - 2. Use quick response sprinklers where allowed by NFPA 13 and suitable for the specific project.
  - 3. Finished Areas: Use standard spray, semi-recessed, chrome finish sprinklers. Coordinate with Architect and University Project Manager.
  - 4. Corrosive Atmospheres: Coated sprinklers to prevent deterioration.
  - 5. Non-finished areas: Brass finish, ordinary temperature rating.
  - 6. Mechanical rooms/attics: Brass finish, intermediate temperature rating.
  - 7. Localized areas with potential for freezing: Dry pendant or dry pendant sidewall sprinklers.
  - 8. Metal Cabinet and Spare Sprinklers: Refer to Section 01 78 46 – Extra Stock Materials.
  - 9. Guards: Provide on sprinklers subject to damage or located within 7 feet of the floor, or as otherwise indicated for special conditions.
  - 10. Spare Parts: Refer to Section 01 78 46 – Extra Stock Materials.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Pipe inspectors test valve discharge to a wastewater drain. Pipe main drain to a wastewater drain.
- B. Coordinate the installation of fire protection materials and equipment above and below ceilings with suspension system, light fixtures, and other building components.
- C. Where mounting heights are not detailed or dimensioned, install overhead fire protection services and equipment to provide maximum headroom possible. Install a minimum 1-1/4 inch threaded capped connection on the end of each cross main to facilitate flushing.
- D. Do not attach the system riser to the supply connection until the underground piping is flushed, tested, and accepted by the Authority having Jurisdiction.
- E. Conceal piping in all areas except mechanical rooms and areas noted on the drawings.
- F. Install sight glasses on inspector's test connections where discharge cannot be seen while valves are operated.
- G. Install a concrete splash block with a minimum length of 4 feet to direct the drain or test discharge water away from the building.
- H. Install tamper switches on all system shutoff valves.

- I. Identification:
  - 1. Valves: identify and label all sprinkler valves. Attach caution signs to all valves controlling water to sprinkler systems in accordance with NFPA 13.
  - 2. Miscellaneous Fire Lines: Label inspector's test drain lines, main drain, and fire lines.
  - 3. Nameplate: Mount hydraulic designed information nameplate at alarm valve and include information in accordance with NFPA 13.

### 3.2 TESTING, CLEANING, AND CERTIFICATION

- A. Record inspections and testing on a copy of Material and Test Certificates as shown in NFPA 13.
- B. Prior to any test on sprinkler/standpipe systems, flush piping to remove any foreign matter.
- C. Hydrostatically test all systems, including fire department connection, to not less than 200 psi for 2 hours. Read test pressure from gauge located at low point of system.
- D. Additionally, test dry-pipe and pre-action systems with an air pressure of 40 psi which is allowed to stand 24 hours. Stop all leaks that allow a loss of pressure over 1-1/2 psi over 24 hours.
- E. Correct leaks immediately. On threaded pipe, tighten joints. If necessary, dismantle and replace section. Caulking, preening, or stop-leak compounds are not permitted.
- F. Test backflow preventer in accordance with state requirements by certified tester.
- G. Function Trip Test:
  - 1. Wet Pipe System: Functionally trip test system components and alarms by opening the inspector's test connection.
  - 2. Dry Pipe and Pre-action Systems: Functionally trip test system components and alarms by opening the inspector's test connection. Maximum dry valve trip test time shall be 15 seconds from the time the inspector's test valve is completely open. Maximum water delivery time to the inspector's test shall be 60 seconds from the time the inspector's test valve is completely open.
- H. Provide backflow preventer state test certification.

### 3.3 COMMISSIONING (DEMONSTRATION)

- A. Provide 4 hours of instruction to the University Facilities Operations personnel. Include valve and drain locations, pipe routing, maintenance and testing procedures.

**END OF SECTION 21 05 00**

## **SECTION 23 00 00 – PLUMBING, HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)**

### **PART 1 - GENERAL**

#### **1.1 REFERENCES**

- A. Manual Part 3, Project Planning and Design Guidelines and Standards
- B. Drawing and General Provisions of Contract, including General and Supplementary General Conditions and Division 1 section apply to work in Division 23.
- C. Codes and Standards: Reference Architect's agreement. Include referenced codes and standards in Contract specifications.

#### **1.2 SYSTEM DESIGN REQUIREMENTS**

- A. Certain operations require special HVAC systems consisting of filtration, humidity control, special exhaust systems, or different temperature settings than surrounding spaces. These areas may include, autoclaves, lab equipment, print shop equipment, machine shop equipment, carpentry shop equipment, metal working shops, and laboratories involved in higher level chemical, biological, and radioactive material experimentation. Work with the University Project Manager to identify these areas and determine appropriate design parameters.
- B. Notify the University Project Manager of all modifications affecting supply and exhaust air in animal rooms, laboratories, environmental chambers, confined spaces, trailers, office spaces, darkrooms, and buildings or spaces being renovated or modified for special occupancies.
- C. Obtain a complete list of the chemicals and gases to be used and stored in laboratories. Use this list to determine fume hood exhaust for flammability, toxicity, corrosiveness, and explosion hazards.
- D. If perchloric acid is used, provide a specialized, dedicated hood constructed of stainless steel, porcelain coated, or non-plasticized PVC lined. Label hood "for perchloric acid use only". Provide the hood with its own non-reactive duct and exhaust fan and built-in water wash-down system.
- E. Provide galvanized steel, aluminum, PVC coated, or stainless steel ducts for ventilating bio safety cabinets, chemical fume hoods and flammable storage cabinets. Design and install systems to ensure that hoods and ducts are under negative pressure all the way out of the building.
- F. If a hood is tied into an existing central exhaust system serving multiple fume hoods, then the air system will need to be evaluated to determine if it has sufficient capacity for the addition of other exhausted equipment.
- G. Provide make-up air to compensate for the air being exhausted. The location and volume of make-up air is critical to assuring proper fume hood operation and worker protection.
- H. Pipe and Duct Penetrations:
  - 1. Specify and detail the manner in which pipes pass through roofs, walls, floors, and ceilings. Fire ratings must be maintained for all penetrations. The Contractor responsible for cutting or drilling holes and flashing, sealing, or otherwise furnishing them must be clearly designated in the project documents.

2. Design pipe, and duct penetrations so that minimum opening remains after installation. Seal openings to prevent passage of rodents, birds, bugs, fire and smoke. Materials used shall be sufficient to maintain fire rating of the wall, floor, ceiling and/or roofs.
  3. Provide for continuous insulation for pipes and ducts passing through openings.
  4. Provide tubing or pipe (not sheet metal) sleeves for all utility services passing through structural walls and slabs. All sleeves passing through slab floors shall project a minimum of 1 inch above the slab and be sealed water tight to the slab.
  5. Provide toe boards and handrails when floor grating is more than 4 feet above the walking surface below.
- I. Provide concrete curbs in mechanical rooms to contain water spills.
- J. Access/Accessibility:
1. Any device, equipment and/or component having a moving part or that requires maintenance and/or service shall be easily accessible. If it is located above solid ceiling, in a chase or other concealed areas, an access door shall be provided so that parts can be exchanged and work be done as required. Minimum panel size to be 24 inches by 24 inches
  2. Design and install utility distribution systems (i.e., conduit, piping, ductwork, etc.) in a layered configuration in the areas of renovation or new construction. Take into account the access to devices, equipment, and/or components.
  3. Locate access to equipment and valves outside critical areas, clean rooms, and red zones. Obtain a list of specific areas from the University Project Manager.
  4. Locate systems to provide access to devices and components that require access or maintenance. Design system hierarchy above ceilings as follows:
    - a. Plumbing waste, vent piping and roof drain mains and leaders.
    - b. Cable trays
    - c. Supply, return, and exhaust ductwork
    - d. Fire sprinkler mains and leaders.
    - e. Electrical conduit and duct banks.
    - f. Domestic hot and cold water, medical gas piping
    - g. Fire sprinkler branch piping and sprinkler run-outs.
  5. Submit a system layering plan including electrical components to the University Project Manager for review and approval as part of the Schematic design phase of each project.
- K. Acoustical Criteria:
1. Design systems to provide noise levels from equipment and ductwork not to exceed, ASHRAE NC-35 in class room, 40-45 in laboratories in all 8 octave bands.
  2. Coordinate acoustical requirements for application specific areas.
  3. Exceptions:
    - a. Spaces within 15 foot radius from supply and return ducts from shafts: NC-40.
    - b. Lobbies, Toilets, Commercial Areas: NC-45 – 50
    - c. Kitchens: NC-45 to 50.
    - d. Mechanical Rooms: NC-50 to 60.
- L. Temporary Facilities:
1. Do not use permanent building equipment without written permission from the University Project Manager. If equipment is used for temporary heating or cooling, maintain equipment per manufacturer's instructions and protect with filters, strainers, controls, reliefs, etc. Do not start the guarantee period until the equipment is turned over to the university for use.
- M. Painting:
1. All piping, conduit and equipment in unfinished areas shall be painted as required for preservation and identification.
  2. All exposed work in finished areas shall be painted for appearance as directed by the Architect.

3. Painters will cover or mask off equipment tags, nameplates, etc., before painting and then remove masking in such a way that it does not destroy the information on the tag or nameplate.

N. Process and Control Air:

1. Air supply for control of HVAC devices having electric or electronic components shall be dried through a refrigeration air dryer or desiccant dryer.

1.3 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 accepted)
    - 2) Product and performance data (reviewed and accepted)
    - 3) Installation instructions
    - 4) Lubrication instructions
    - 5) Wiring and temperature control diagrams (reviewed and accepted Shop 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.
    - 4. Provide standard long-form specifications.
  - D. Spare Parts: Refer to Section 01 78 46 – Extra Stock Materials.
- 1.4 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. (ASHRAE) American Society of Heating, Refrigerating and Air Conditioning Engineers
    - 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)
- 1.5 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 01 10 00.
- 1.6 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.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. As specified in individual sections.

### 2.2 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 01 25 00.

## PART 3 - EXECUTION

- A. Additional charges will not be authorized due to the contractor's failure to become familiar with the existing conditions.

### 3.2 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. Responsibility of Contractor:

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.
    - a. 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.
    - a. Repair damaged factory finishes to match adjacent, undamaged areas.
    - b. Replace deformed metal cabinets, jackets, and enclosures with new items. Finish shall match similar undamaged items.

### 3.3 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.
      - 1) Clean exposed surfaces of piping, ducts, and hangers.
      - 2) Clean equipment cabinets and enclosures.
      - 3) Provide and install new filters for equipment.
- B. Project Closeout:
  - 1. 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.

### 3.4 COMMISSIONING (DEMONSTRATION)

- A. 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 23 00 00**

## SECTION 23 05 13 - MOTORS

### PART 1 - GENERAL

#### 1.1 WARRANTY

- A. Provide option for an extended warranty package on variable frequency drive package including motor matched to drive.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. Motors
    - a. Baldor
    - b. Magnetek
    - c. Toshiba

#### 2.2 MATERIALS, GENERAL

- A. Motor Frames and Mounts: Equip motor frames with two axis adjustments, namely slotted frame ends for adjusting in shaft direction and two adjusting screws for belt tensioning.
  - 1. Motor sizes shall be large enough so that the driven load will not require the motor to operate in the service factor range.
  - 2. Motors shall be capable of starting the driven equipment while operating at 90 percent rated terminal voltage.
  - 3. Service Factor: 1.15 for poly-phase motors and 1.35 for single phase motors.
  - 4. Motor Construction: NEMA Standard MG 1, general purpose, continuous duty, Design "B", except "C" where required for high starting torque.
  - 5. Provide inverter-duty motors specifically designed for variable speed operation with premium efficiency at part load conditions a constructed with Class F insulation for equipment specified to operate with variable frequency drives.
  - 6. Phases and Current characteristics: Unless indicated otherwise, provide squirrel-cage induction poly-phase motors for 3/4 hp and larger, and provide capacitor-start single-phase motors for 1/2 hp and smaller, except 1/6 hp and smaller may be split-phase type.
  - 7. Provide motors for operation at 5000 foot elevation or higher.
  - 8. Motors smaller than 1 hp to be single-phase. Motors larger than 1 hp to be 3-phase.
  - 9. Motors 1 HP and larger shall be inverter-duty, with nominal efficiency equal to or greater than that stated in NEMA Standard MG1, 1.41.3.
  - 10. Match motor electrically to the drive (a package unit).
  - 11. Motors for pulse-width modulating (PWM) drives will have both motor bearings isolated.
  - 12. Motors, 5hp and larger, must be driven by PWM.
  - 13. Bearings:
    - a. Ball or roller bearings with inner and outer seals on sizes up to 1.5". Ball or roller bearings with inner and outer shields on sizes greater than 1.5" shaft dia.
    - b. Regreasable except permanently sealed where motor is normally inaccessible for regular maintenance.
    - c. Sleeve type for light-duty, fractional horsepower equipment.
- B. Drives:
  - 1. Rated capacity of V-Belt drives shall not be less than 150 percent of motor nameplate horsepower.

2. Fixed pitch sheaves, including single groove fan sheaves shall be of the bushed type. No fixed pitch sheave shall be smaller than 3" dia.
3. Variable pitch sheaves are not allowed.
4. Provide OSHA approved belt guard with tachometer holes.
5. For equipment serving hazardous or critical systems such as fume hoods, and bio-hazards, provide fans with a minimum of two-groove sheaves and fan belts.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION, GENERAL

- A. Motor Frames and Mounts: Mounts for adjustments of belt tension shall be of the two-pull variety.
- B. Variable Frequency Drives: Install floor mounted variable frequency drives on 4-inch high concrete housekeeping pad.
- C. Correction for long-lead length at the motor will be the responsibility of the installer. Electrical correction will be implemented as required to achieve and maintain safe and smooth motor operation.
- D. Disconnect at the motor shall have auxiliary contact so that when disconnect is opened the control circuitry to the drive will be interrupted. Provided by Division 26.
- E. VFD shall have sheet metal splash pans above the drives when hydronic piping is located above the VFD.

#### 3.2 TESTING, CLEANING, AND CERTIFICATION

- A. Factory test variable frequency drives under simulated operation. Provide certification of factory test.
- B. Testing: Test and start VFD's and bypass under actual conditions by factory trained personnel. Operate VFD's through its full range to determine resonant speeds,.

#### 3.3 COMMISSIONING (DEMONSTRATION)

- A. Start-up of variable frequency drive equipment shall be performed by factory authorized representative. Provide checklist certifying equipment startup and operation.

#### 3.4 TRAINING

- A. Provide the university's representative 2 hours of training by factory authorized representative for each variable frequency drive installed. Training includes startup, shutdown, emergency operation, maintenance and servicing.

**END OF SECTION 23 05 13**

## SECTION 23 05 19 - METERS AND GAUGES

### PART 1 - PRODUCTS

#### 1.1 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Glass Thermometers:
    - a. Marshalltown Instruments, Inc.
    - b. U.S. Gage
    - c. Mueller
  2. Direct Mount Dial Thermometers:
    - a. Marsh Instrument Co.; Unit of General Signal
    - b. Terice (H.O.) Co.
    - c. Weiss Instruments, Inc.
  3. Remote Reading Dial Thermometers:
    - a. Ametek/U.S. Gauge
    - b. Marsh Instrument Co.; Unit of General Signal
    - c. Weiss Instruments, Inc.
  4. Dual Type Insertion Thermometers and Wells:
    - a. Marsh Instrument Co.; Unit of General Signal
    - b. Taylor Instrument Co.
    - c. Weiss Instruments, Inc.
  5. Temperature Gauge Connector Plugs:
    - a. Fairfax Company
    - b. Peterson Equipment Co.
    - c. Universal Lancaster

#### 1.2 MATERIALS, GENERAL

- A. Thermometers:
1. Case: Die cast aluminum, finished in baked epoxy enamel, glass front, spring secured, 9 inches long.
  2. Adjustable Joint: Die cast aluminum, finished to match case, 180 degree adjustment in vertical plane, 360 degree adjustment in horizontal plane, with locking device.
  3. Tube and Capillary: Spirit filled, magnifying lens, 1% scale range accuracy, shock mounted.
  4. Scale: Satin faced, non-reflective aluminum, permanently etched markings.
  5. Stem: Copper plated steel, or brass, for separable socket, length to suit installation.
  6. Range: Conform to the following:
    - a. Hot Water: 30 degree - 240 degree F with 2 degree F scale divisions.
    - b. Chilled Water: 0 degree - 100 degree F with 2 degree F scale divisions.
- B. Dial Type Insertion Thermometers
1. Type: Bi-metal, stainless steel case and stem, 1 inch diameter dial, dust and leak proof, 1/8 inch diameter stem with nominal length of 5 inches.
  2. Accuracy: 0.5% of dial range.
  3. Range: Conform to the following:
    - a. Hot Water: 0 degree - 240 degree F
    - b. Chilled Water: 0 degree - 100 degree.
- C. Thermometer Wells:

1. Thermometer wells constructed of brass or stainless steel, pressure rated to match piping system design pressure. Provide 2 inch extension for insulated piping. Provide cap nut with chain fastened permanently to thermometer well.
- D. Temperature Gauge Connector Plugs:
1. Temperature gauge connector plugs pressure rated for 500 psi and 200 degree F (93 degree C). Construct of brass and finish in nickel-plate, equip with 1/2 inch NPS fitting, with self-sealing valve core type neoprene gasketed orifice suitable for inserting 1/8 inch OD probe assembly from dial type insertion thermometer. Equip orifice with gasketed screw cap and chain. Provide extension, length equal to insulation thickness, for insulated piping.
- E. Calibrated Balance Valves:
1. Calibrated balance valves equipped with readout valves to facilitate connecting of differential pressure meter to balance valves. Equip each readout valve with integral EPT check valve designed to minimize system fluid loss during monitoring process. Provide calibrated nameplate to indicated degree of closure of precision machined orifice. Construct balancing valve with internal EPT O-ring seals to prevent leakage around rotating element. Provide balance valves with preformed polyurethane insulation suitable for use on heating and cooling systems, and to protect balance valves during shipment.

## PART 2 - EXECUTION

### 2.1 INSTALLATION, GENERAL

- A. Temperature Gauges:
1. General: Install temperature gauges in vertical upright position, and tilted so as to be easily read by observer standing on floor.
  2. Locations: Provide in the following locations and elsewhere as indicated:
    - a. At inlet and outlet of each hydronic coil.
  3. Thermometer Wells: In vertical upright position. Fill well with oil or graphite, secure cap.
  4. Temperature Gauge Connector Plugs: Located on pipe at most readable position. Secure cap.

### 2.2 TESTING, CLEANING AND CERTIFICATION

- A. Adjusting: Adjust faces of meters and gauges to proper angle for best visibility.
- B. Cleaning: Clean windows to meters and gauges and factory-finished surfaces. Replace cracked or broken windows, repair any scratched or marred surfaces with manufacturer's touch-up paint.
- C. Certification: Provide meters and gauges whose accuracies, under specified operating conditions, are certified by manufacturer.

**END OF SECTION 23 05 19**

## SECTION 23 05 23 - GENERAL-DUTY VALVES FOR PIPING

### PART 1 – GENERAL

#### 1.1 SYSTEM DESIGN REQUIREMENTS

- A. General Information:
  - 1. Show all valves on the drawings. Do not rely on a general note in the specifications or on the plans.
  - 2. For applications up to 2", specify full port ball valves. Butterfly valves are acceptable if pressure and leak risks are low.
  - 3. Valves adjacent to equipment should have unions/flanges provided to allow for removal with minimal labor effort.
- B. Isolation Valves:
  - 1. Provide valves for isolating sections of piping systems. It should be possible to isolate; the entire building, separate floors, separate wings, toilet rooms, machinery rooms and other natural subdivisions of the buildings.
  - 2. Provide valves for isolating equipment and fixtures. Place valves on both sides of backflow and check valves to permit inspection.
  - 3. Do not use isolation valves for balancing and do not use balancing valves for isolation.
  - 4. Isolation valves can be ball type (up to 2 inch), gate, or butterfly as deemed appropriate by designer for the type of service, pressure, and fluid.
  - 5. Ball valves are acceptable as isolation valves for most hot water heating systems, domestic water systems, distilled or ionized water systems, blow-down valves, drain valves and other low hazard, low pressure systems.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Hydronic Ball Valves:, Apollo, Crane, Jamesbury or Jenkins.
- B. Heating Water P/T Relief Valves: Bell & Gossett, Watts, Farris, Kunkle, Watts Regulator Co., or Spirax Sarco.
- C. Circuit Setters: FDI, Armstrong, Bell & Gossett, Tour Anderson.

#### 2.2 MATERIALS, GENERAL

- A. Ball Valves:
  - 1. Blowout proof stems, 3-piece, full port type, brass or bronze body, chrome plated or stainless steel ball, Teflon seals and seat, vinyl-covered handle with memory stop. Pressure rating 150 psi SWP and 600 psi WOG.
  - 2. Ball valves shall be 2 inch or less. Larger pipe sizes shall require gate or butterfly valves.
- B. Balancing or Throttling Valves:
  - 1. Use eccentric plug, globe or angle valves for balancing. Do not use gate valves.
  - 2. Butterfly valves equipped with memory stops may be used as balancing valves.
- C. Safety Relief Valves: Brass or bronze body, designed, rated, and stamped in accordance with ASME. Steel and cast iron body valves may be used for steam service.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. General Duty Valve Applications: The drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
  - 1. Shutoff duty: Use valve type as indicated on drawings and in this section.
  - 2. Throttling duty: Use globe (steam only) and plug (heating and chilled water).
- B. Install shutoff duty valves at each branch connection to supply mains, at supply mains, at supply connection to each piece of equipment and elsewhere as indicated.
- C. Install throttling duty valves at each branch connection to return mains, at return connections to each piece of equipment, elsewhere as indicated.
- D. Install plug valves on the outlet of each heating or cooling element and elsewhere as required to facilitate system balancing.
- E. Install drain valves at low points in mains, risers, branch lines, and elsewhere as required for system drainage. Provide 1/2-inch ball valves with chain end cap at all tops of risers to be used for venting.
- F. Install pump discharge valves with stem in upward position; allow clearance above stem for check mechanism removal.
- G. Install safety relief valves on hot water generators, and elsewhere as required by ASME Boiler and Pressure Vessel Code. Pipe discharge to floor without valves. Comply with ASME Boiler and Pressure Vessel Code Section VIII, Division 1 for installation requirements.
- H. Install pressure reducing valves on hot water generators, and elsewhere as required to regulate system pressure.
- I. Install valves with stems upright or 45 degree maximum, never inverted. When and if steam valves have to be mounted inverted they shall have a valve bonnet drain.
- J. Mount all valves so operation is possible without interference from pipes, pipe hangers, walls, etc.
- K. Valves (4 inches and larger) located more than 7 feet above floor in mechanical equipment rooms shall be chain operated.
- L. Install valves easily accessible. Provide access panels when it becomes necessary to install valves above gypsum ceilings.

**END OF SECTION 23 05 23**

## SECTION 23 05 53 - IDENTIFICATION FOR PIPING AND EQUIPMENT

### PART 1 - GENERAL (NOT USED)

### PART 2 - PRODUCTS

#### 2.1 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

#### 2.2 MATERIALS, GENERAL

- A. Plastic Pipe Markers
  - 1. Pipe labels that adhere to pipe or insulation surface with directional arrows.
- B. Tags:
  - 1. Engraved anodized aluminum or engraved plastic, 2-inch diameter. Pre-punched and provided with brass chain.
- C. Labels and Nameplates:
  - 1. Laminated three-layer plastic with black engraved letters on light contrasting background color, drilled for mounting with two sheet metal or brass screws. Pressure-sensitive embossed labels are not acceptable.
- D. Paint:
  - 1. Exterior grade oil-based alkaloid gloss stenciling spray paint. Color complying with NEMA Z535.1.
- E. Valve Schedule Frames:
  - 1. Provide frames of finished hardwood or extruded aluminum, with non-glare glass.

### PART 3 - EXECUTION

#### 3.1 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
  - 1. 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:
  - a. 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:
    - 1) 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.
    - 2) If flow can be in both directions, use a double-headed arrow indication.
    - 3) Apply pipe legend and arrow indication at every point of pipe entry or exit where line goes through wall or ceiling cut.
    - 4) Apply pipe legend and arrow indication within 3 inch of each valve to show proper identification of pipe contents and direction of flow.
    - 5) Apply legend to the pipe so that lettering is in the most legible position. For overhead piping, apply legend on the lower half of the pipe where view is unobstructed, so that legend can be read at a glance from floor level.
    - 6) Pipes under 3/4 inch O.D.: Fasten brass tags securely at specified legend locations.
    - 7) 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. Fans:
  - a. Label exhaust fans, air handling units and connecting ductwork supplying one or more areas from an equipment room or isolated crawl or furred space. Install nameplate or stencil as to plan code number, service and areas or zones served.
5. 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.

### 3.2 SCHEDULES

#### A. Piping Identification

Classification	Color of Field	The Campus Letters	Legend
Extreme Temperatures or Pressures:	Yellow	Black	
Domestic Hot Water	Yellow	Black	Dom HW
Domestic Hot Water, Circulating	Yellow	Black	Dom HWC
Heating Water Supply	Yellow	Black	HWS
Heating Water Return	Yellow	Black	HWR

Classification	Color of Field	The Campus Letters	Legend
Refrigerant	Yellow	Black	REF
High Pressure Compressed Air (over 90 psig)	Yellow	Black	CA
Fire Quenching Materials:			
Fire Lines	Red	White	FL

B. Mechanical Equipment Naming Strategy:

- Equipment identification numbers may be up to 32 characters. Equipment naming strategy is:  
System – Bld – Number  
###-#####-##-###
- The first three placeholders are reserved for the system designation (alpha characters)
- The fourth character is a hyphen.
- The fifth through ninth placeholders are reserved for the building designation (alpha and/or numeric)
- The tenth character is a hyphen
- The eleventh through sixteenth placeholders are a “smart number.” It is composed of a two-digit, alpha or numeric, floor location designator followed by a hyphen and a three digit numeric sequential indicator.
- The seventeenth character is a hyphen
- In some instances the point name will be followed by a hyphen and a sub-point name
- All device and point names will be assigned by the Facilities Operations, Building Operations Department.
- All references to equipment and devices in drawings, labels, equipment tags, BAS system, etc., must use this naming convention.
- Equipment designation, for prints may exclude the building designator.

**END OF SECTION 23 05 53**

## SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

### PART 1 - GENERAL

#### 1.1 SYSTEM PERFORMANCE REQUIREMENTS

- A. Require general, mechanical and electrical contractors 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. Method of adjusting outside and return air quantities at air handling units.
    - h. Initial test procedures for preliminary balance.
    - i. Final test procedures.
    - j. List of deficiencies in mechanical system that could hinder the balance work such as missing or leaky dampers, incomplete systems, inadequate fans, etc.
    - k. Sample of data sheets and test forms to be used in final report.
    - l. 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.

## PART 2 - PRODUCTS (NOT USED)

## PART 3 - EXECUTION

### 3.1 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.

I. Balancing:

1. Water Balance:

- a. Balance water piping and snow melt 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.
- b. 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.
- c. Indicate and record final position of balancing valves.
- d. Primary-Secondary Flow Systems: Balance primary system crossover flow first, then balance secondary system.
- e. Water Coils:
  - 1) Measure entering and exiting water temperatures and pressures.
  - 2) Measure water flow rate.
  - 3) Measure entering and exiting dry, and wet, bulb air temperatures.
  - 4) Measure airflow. Measure air pressure drop. Calculate capacity in btu-h.

2. Air Balance:

- a. Balance duct system to produce air quantities within 10 percent of indicated value.
- b. 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.
- c. Place all fans (supply, return, and exhaust) in operation. Load or restrict filters to increase pressure drop to 50% of span between initial pressure drop and final recommended pressure drop for setting final air flows for fans. Check the following:
  - 1) Motor amperage and voltage to guard against overload.
  - 2) Fan rotation.
  - 3) Operability of static pressure limit switch.
  - 4) Automatic dampers for proper position.
  - 5) Air and water resets operating to deliver required temperatures.
  - 6) Air leaks in casing and in safing around coils and filter frames.
- d. Traverse Main and Branch Ducts: Perform pitot traverses for fan total air flows including traverses for hot and cold decks, for each zone in multi-zone systems and for each floor. Mark locations of pitot traverses on reduced drawings in final report.
  - 1) Note temperature and barometric pressure. Corrections shall be made for systems operating at 5200-foot elevation.
  - 2) After establishing total air being delivered, adjust fan speed to obtain design airflow. Check power and speed to see that motor power and critical fan speed have not been exceeded.
  - 3) Proportionally adjust branch dampers until each has proper air volume.
  - 4) With all dampers and registers in system open and with supply, return, and exhaust fans operating at design cfm or speed, set minimum outdoor and return air ratio.
  - 5) After minimum outside air damper has been set for proper percentage of outside air, take another traverse of mixture temperatures. Notify the University Project Manager and note in balancing report if variation from average is more than 5 percent.
- e. Adjust system with mixing dampers positioned for minimum outside air.
- f. 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.
- g. Balance constant volume reheat systems in one mode, namely design airflow.

- h. Balance constant volume dual duct systems at the boxes for full cooling and full heating air flows. Balance the fan with all the boxes on full cooling. Record the total fan supply with the boxes on full cooling.
- i. Once total design air has been balanced in branches and at outlets, verify and record the following:
  - 1) Fan motor amperage.
  - 2) Fan speed
  - 3) Fan cfm.
  - 4) Fan outlet velocity.
  - 5) External and total static pressure.
  - 6) Supply, return, mixed, and outside air temperatures.
  - 7) Percent outside air under minimum damper position.
  - 8) Static pressure across each component (intake, filters, coils, and mixing dampers).
  - 9) Take a final duct traverse.
- j. Final adjustments shall include, but not be limited to the following:
  - 1) Adjust RPM on belt drive fans. Include sheave and belt exchange to deliver air flow within limits of installed motor horsepower and mechanical stress limits of the fan. Determine limiting fan tip speed before increasing RPM. Final fan speed setting shall allow for filter loading and shall establish proper duct pressures for operation of zone cfm regulators.
  - 2) Replace all variable pitched sheaves with fixed pitched sheaves. This includes such devices as fan coils.
  - 3) Adjust rpm on Direct Drive Fans:
    - a) For motors with speed taps, set fan speed on tap which most closely approaches design cfm. Report tap setting on equipment data sheet as high, medium, or low.
    - b) For motors with speed control, set output of fan at design cfm by adjusting control. Ensure the fans restart after shut down. Increase setting as required for proper setting. Mark control to indicate final setting position.
  - 4) Terminal Boxes:
    - 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.
- 3. Equipment Motors: Record the following information for every motor and include information with the appropriate equipment.
  - a. Motor horsepower and rpm.
  - b. Nameplate and measured voltage and amperage, each phase.
  - c. Motor Starters and Thermal Heaters: Check for correct sizing for proper motor protection on magnetic and manual starters.
- J. Report:
  - 1. 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:

- a. General Information and Summary
  - b. Air Systems
  - c. Hydronic Systems
  - d. Temperature Control Systems
  - e. Special Systems such as fume hood exhaust systems.
  - f. Sound and Vibration Systems
  - g. Recommendations.
2. Report Contents: Provide following minimum information, forms, and data:
- a. General Information and Summary:
    - 1) Inside cover sheet to identify testing, adjusting, and balancing agency, contractor, and project name. Include contact names, addresses, and telephone numbers.
    - 2) Certification sheet containing seal, address, telephone number, and signature of Certified Test and Balance Engineer.
    - 3) Listing of instrumentation used for procedures along with proof of calibration.
  - b. 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.
    - 1) Air Handling Units and Fans: Air handling unit, fan and motor nameplate information, type, drive sheave information (as installed and changed), and final belt number and size.
    - 2) Air Balance for Supply, Return, Relief, and Exhaust Systems:
      - a) Outlets, Inlets, Diffusers, Registers, and Grilles: Size, reading orifice size, velocity in fpm, and design and final balanced air quantity in cfm.
      - b) Terminal Boxes: Design and final minimum and maximum cfm settings including fan cfm on fan powered terminal boxes.
      - c) Ducts: Size, velocity in fpm, and air quantity in cfm.
    - 3) Hydronic Balance:
      - a) Water coil size and manufacturer.
      - b) Boiler and burner nameplate information and flue gas analysis. Flue gas analysis shall be copy of manufacturer's analysis report.
      - c) Chiller and motor nameplate information.
      - d) Cooling tower and fan motor nameplate information.
      - e) Pump and motor nameplate information. Include manufacturer's pump curves.
      - f) Heat exchanger nameplate information.
      - g) Snow melt circuits.
    - 4) 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.
    - 5) Include sheet that reports method of balance, project altitude, and any correction factors used in calculations.
    - 6) 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.
    - 7) Prepare list of recommendations for correcting unsatisfactory mechanical performances when system cannot be successfully balanced.

### 3.2 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.

### 3.3 COMMISSIONING (DEMONSTRATION)

- 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 23 05 93**



## SECTION 23 07 00 – INSULATION

### PART 1 - GENERAL

#### 1.1 SYSTEM DESIGN REQUIREMENTS

- A. Provide minimum insulation thickness as suggested in ASHRAE Standard 90A.
- B. Provide removable insulation for chilled water pumps and specialty valves and fittings.

#### 1.2 DEFINITIONS

- A. Concealed: As used in this Section refers to insulation in ceiling plenums, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, unexcavated areas, and crawl spaces.
- B. Exposed: As used in this Section refers to insulation that is not concealed.

#### 1.3 QUALITY ASSURANCE

- A. Composite insulation, including jackets, coverings, sealers, mastics, and wet or dry adhesives shall have a flame spread rating of 25 or less and smoke-developed rating of 50 or less, as tested by ASTM E84.
- B. Elastomeric foam with a smoke-developed rating of 150 or less may be used, except in ducts, plenums, and concealed spaces that are part of the air distribution system
- C. PVC fitting covers shall have a maximum flame spread of 25 or less and are exempted from the smoke spread criteria.
- D. Duct liner shall comply with NAIMA Fibrous Glass Duct Liner Standard.

### PART 2 - PRODUCTS

#### 2.1 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

#### 2.2 MATERIALS, GENERAL

- A. Pipe Insulation:
  - 1. Glass Fiber:
    - a. 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:
1. PVC Plastic: One-piece, UV-resistant, 20-mil thick, molded type, gloss white finish with fiberglass insulation insert for fittings.
    - a. Manville Zeston 2000 (indoors).
    - b. Manville Zeston 300 (outdoors).
  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:
    - a. 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.
- 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.
  2. Outdoor Duct Jacketing:
    - a. Aluminum: 0.016-inch thick sheet with smooth or embossed finish, longitudinal slip joints with 2-inch laps.
    - b. Non water-vapor retarder: Non-burning, weatherproof coating, Manville Insulkote ET.
    - c. PVC plastic: 30mil thickness, UV resistant, Manville Zeston, 300 Series.
- E. Fire-stop Insulation:
1. Flexible blanket, amorphous wool:
    - a. Thermal Conductivity (k value): 0.85 at 1000 degrees F and 1.70 at 1800 degrees F
    - b. Continuous use-temperature rating: 1834 degrees F
    - c. Melting point: 2327 degrees F
    - d. Density: 6 pounds per cubic foot.
    - e. Thermal Ceramics SF607.
- F. Fixed and Removable Valve Insulation:
1. Insulate valves, strainers and other equipment on steam, condensate, and hot water lines.
  2. Steam and Hot Water Valves:
    - a. 3 inch and larger: Insulate with removable insulation jacket.
    - b. 2-1/2 inch and smaller: Do not insulate unless removable type is shown to be cost effective or effect of heat loss is shown to be detrimental.
  3. Removable Insulation Jackets:
    - a. 1 inch thick fiberglass insulation.
    - b. Density: 9 to 11 lb. Pcf.
    - c. Maximum Service Temperature: 1000 degree F.
    - d. Secure with stainless steel quilting pins.
    - e. Inner and Outer Jacket: Silicone coated fiberglass, 34 oz. per sq. yard, chemical resistant, suitable for temperatures to 500 degree F.
    - f. Seam Closure: Teflon coated fiberglass threads suitable for temperatures to 600-degree F. of type 20 lb. Tensile strength.
    - g. Fastening System: Type 304 stainless steel double D-rings with silicone coated fiberglass belts with Velcro on ends. 1-inch wide belt sewn to adjacent insulation, flanges, etc. Stainless steel wire cords, minimum 1/4 inch diameter and Teflon coated.
    - h. Identification: Furnish type 304 stainless steel or aluminum I.D. tag riveted to jacket with item description, location and factory number.
- G. Utility Vault Pipe Insulation
1. Steam and condensate line insulation
    - a. Closed-cell fiberglass
    - b. All insulation surfaces shall be protected by metal jacketing
  2. Chilled water supply and return insulation
    - a. Closed-cell fiberglass
    - b. Required insulation thickness
    - c. All insulation surfaces shall be protected by metal jacketing

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL:

#### A. Overview:

1. 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.
2. Continue insulation vapor barriers through penetrations except where prohibited by code.
3. 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.
4. 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.
5. Seal all exposed raw edges of insulation with vapor retarder or finishing cement.
6. 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.
7. Do not weld insulation support pins to pressure vessels.
8. 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:

Pipe Size Inches	Insert Length Inches
1-1/2	6
2 through 9	9
10 through 14	12
16 through 24	18

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.
9. Exterior applications: Install PVC jacket and fitting covers or aluminum jacket over insulated pipe, fittings, joints, and valves. Locate jacket seams on bottom side of horizontal piping. Cover all valves, flanges, unions, accessories, and fittings with aluminum jacket. Seal jacket watertight and secure with lock type aluminum bands.
10. Refrigerant piping insulated with elastomeric insulation: Seal joints with elastomeric sealant made by same manufacturer as the insulation. For outdoor locations, paint insulation white or silver. Paint shall be compatible with the insulation.

11. Piping under concrete slabs on grade: Spiral wrap insulation with Protecto Wrap 200 coating with 50% overlap. Lay the insulated and wrapped piping on a 3-inch bed of sand and cover with 3 inches of sand all around.
- 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.
  6. Outdoor Applications: Install insulation with a weather protection jacket.
- D. Installation of Insulation on Fittings and Valves:
1. Factory premolded 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, premolded 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.
- E. Installation of Fire-stop Insulation:
1. Install per listing.

**END OF SECTION 23 07 00**

## SECTION 23 20 00 - PIPING

### PART 1 - GENERAL

#### 1.1 SYSTEM DESIGN REQUIREMENTS

- A. Pipe Connections: Provide required straight sections for flow measurement stations.
- B. Natural Gas Piping Systems:
  - 1. Provide shut-off cocks on all branch lines, and lab benches, and make cocks easily accessible for service and operation. Provide drip legs at all equipment connections. Use pipe dope on threaded pipe fittings, Teflon tape is prohibited.
- C. Sanitary Sewer Piping Systems:
  - 1. Provide manholes at major junctions of exterior sewer lines, and provide cleanouts on all other junctions.
  - 2. Locate interior clean-out caps and plugs such that they can be removed without damaging the surfaces in which they are installed.
  - 3. Do not discharge chemical waste, oils, antifreeze, and other wastes into the sanitary sewer without written approval of the University Project Manager. Coordinate the requirement of acid neutralizing systems and sand and oil interceptors with the University Project Manager.
  - 4. Do not discharge domestic water used for cooling into the sanitary sewer except for emergency back up for critical systems and vacuum systems.
  - 5. Coordinate with regulatory agencies, including Metro Waste Water.
  - 6. Coordinate requirements closely with the University Project Manager.
- D. Potable Water Piping System:
  - 1. Lead pipe or lead solder is prohibited for all potable water piping systems.
  - 2. Make domestic water piping joints with lead free solder.
  - 3. Size domestic water piping to maintain maximum velocities of 8 feet per second for cold water and 5 feet per second on hot water and hot water circulation piping.
  - 4. Provide main shutoff valve for potable water inside the building.
  - 5. As a minimum, provide shut-off valves at each branch, floor, equipment and bathroom group.

#### 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.
- D. Soldering and brazing procedures shall conform to ANSI B9.1 Standard Safety Code for Mechanical Refrigeration.

- 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 WARRANTY:

- A. Manufacturer's warranty of 25 years for snowmelt tube and 18months for snowmelt manifolds.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. Manufacturer's Qualifications: Firms regularly engaged in manufacture 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
  - 2. Piping Connectors
    - a. Fernco, Inc.
  - 3. Pipe Thread Sealant
    - a. The Rectorseal Corp.
  - 4. Drainage Piping Specialties, including backwater valves, expansion joints, drains, cleanouts, flashing flange and vent flashing sleeve.
    - a. JR Smith
    - b. Zurn Industries
    - c. Wade
    - d. Josam
  - 5. Gas Cocks
    - a. Crane
    - b. Hammond
    - c. Peter Healy
- B. Acceptable Manufacturers - Snowmelt: Subject to compliance with requirements, provide products by the following:
  - 1. Tube, Fittings, Pipe, and Manifolds:
    - a. Uponor
    - b. Watts Radiant
    - c. Quest Hydronics
  - 2. Controls: Integrated into BAS (preferred)

### 2.2 MATERIALS, GENERAL - SNOWMELT

- A. Provide components of the buried tubing system by one manufacturer, including tubing, fittings, manifolds, and ancillary items.
- B. Supply and Return Main Pipe:
  - 1. 2 Inch and below: ASTM F876, cross linked polyethylene, rated at 180 degree F maximum working temperature and 100 psi working pressure with oxygen diffusion barrier capable of limiting oxygen diffusion through the tube to no greater than 0.10 g/m<sup>3</sup>/day at 104 degree F.
    - a. Fittings: Brass or Bronze
  - 2. Above 2 Inches: Industrial pressure pipe, HDPE polyethylene pipe, fusion welded.
    - a. Fittings: HDPE, SDR 11, fusion welded.

- C. Access Covers:
  - 1. Removable access covers constructed of reinforced concrete formed in place or precast concrete over pipe connections, fittings, and distribution manifolds. Provide tapered forms for covers. Covers subject to vehicular traffic shall be traffic rated.

## 2.3 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 in not indicated, provide proper selections 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, and 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. 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).
  - 5. Coal Tar Protective Coatings and Linings for Ductile Iron Water Pipe: AWWA C203 for enamel and tape, hot applied.
  - 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).
  - 12. Threaded Pipe Plugs: ANSI B16.14.
  - 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).
  - 16. Wrought-Steel Butt-welded Fittings: ANSI B16.9, except ANSI B16.28 for short-radius elbows and returns; rated to match connected pipe.
  - 17. Cast-Iron Threaded Drainage Fittings: ANSI B16.12.
  - 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 than 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).
- D. 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.
  4. Cast-Copper Solder-Joint Fittings: ANSI B16.18.
  5. Wrought-Copper Solder-Joint Fittings: ANSI B16.22.
  6. Cast-Copper Solder-Join Drainage Fittings: ANSI B16.23 (drainage and vent with DWV or tube).
  7. Wrought-Copper Solder-Joint Drainage Fittings: ANSI B16.29.
  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.
- E. Cast-Iron Soil Pipes and Pipe Fittings:
1. Hubless Cast-Iron Soil Pipe: FS WW-P-401 and CISPI Standards 301 and 310.
  2. Cast-Iron Hub-and-Spigot Soil Pipe Fittings: Match soil pipe units; complying with ASTM A74.
  3. Hubless Cast-iron Soil Pipe Fittings: Neoprene gasket complying with ASTM C564, CISPI Standard 310 and stainless steel clamp holding band.
  4. Cast-Iron Hub-and-Spigot Soil Pipe Fittings: Match soil pipe units; complying with ASTM A74.
  5. Neoprene Compression Gaskets: ASTM C564
- F. Miscellaneous Piping Materials/Products:
1. Welding Materials: Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials.
  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.
- G. 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.
4. Natural Gas:
- a. Within the Building: Schedule 40 black iron pipe, threaded for sizes 2 inches and smaller and welded for 2-1/2 inch and larger. All lines shall be accessible.
  - b. Flex lines to equipment and fixtures shall be stainless steel with epoxy coating on both sides, UL stamped. Other types are prohibited.
  - c. Pipe dope shall be Teflon based. Oil based is not permitted. Teflon tape prohibited.

#### H. REFRIGERANT PIPING

- 1. Line sets are not allowed.
- 2. Tube Material:
  - a. Size 3/4" and smaller: Soft annealed temper copper tube.
  - b. Size 7/8" through 4-1/8": Hard drawn temper copper tube.
  - c. Type ACR.
- 3. Fittings: Wrought-copper, solder-joints, ANSI B16.22.
- 4. Joints: Brazed or soldered with material having shear strength of 10,000 PSI or greater.
- 5. End Caps:
  - a. Provide factory applied plastic end caps on each length of pipe and tube.
  - b. Maintain end caps through shipping, storage and handling as required to prevent pipe end damage and eliminate dirt and moisture from inside of pipe and tube.
- 6. Shut Off Valves:
  - a. Manufacturers:
    - 1) Henry
    - 2) Other Acceptable Manufacturers:
    - 3) Parker Hannifin Corp.
    - 4) Singer
    - 5) Sporlan Valve Co.
    - 6) Size 7/8 Inch and Smaller:
      - a) Model: Series 600.
      - b) Type: Pack-less diaphragm.
      - c) Material: Forged bronze.
      - d) Flow: Non-directional.
      - e) Servicing: Diaphragm changeable under line pressure.
    - 7) Size 1-1/8 Inch and Larger:
      - a) Model: Series 200.
      - b) Type: Wing cap, back seating.
      - c) Material: Bronze.

#### I. Pipe Connectors:

- 1. Manufacturers
  - a. Mason
  - b. Metraflex
  - c. Flexonics
- 2. Braided bronze with copper tube ends, compatible with refrigerant type for system

3. Flexible connector shall be line size or connection size, whichever is larger.
- J. Piping Specialties:
1. Refrigeration Accessories (Strainers, Moisture-Liquid Indicators, Filter-Driers, Evaporator Pressure Regulators, Discharge Line Mufflers, Expansion Valves, Superheat Adjustment):
  2. Manufacturers:
    - a. Alco Controls Division, Emerson Electric Co.
    - b. Henry Valve Co.
    - c. Parker Hannifin Corp.
    - d. Sporlan Valve Co.
  3. Filter Drier:
    - a. Conform to ARI Standard 710.
    - b. Sizes ½" and larger - interchangeable core, full flow.
    - c. Sizes smaller than ½" - sealed type.
    - d. Minimum burst pressure - 1500 psig.
  4. Expansion Valve:
  5. Thermostatic type, diaphragm or bellows operated.
  6. External superheat adjustment factory set for 10°F superheat (adjustable).
  7. Compatible with refrigerant type for the project.
  8. Pressure rated per project requirements.
  9. Power elements and valve size shall be as recommended by the manufacturer, for the service intended.

### PART 3 - EXECUTION

#### 3.1 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 ¾-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.
  6. Hanger Spacing: Per current code.
  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 uninsulated 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.
4. Heat joints using oxy-acetylene torch. Heat to proper and uniform temperature.
5. For all copper piping, ream and remove all burrs prior to making joints.
6. Threaded Joints: Conform to ANSI B1.20.1.
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.

### 3.2 INSTALLATION, GENERAL – REFRIGERATION

- A. Size lines for total pressure drop not to exceed 2° F saturation temperature.
- B. Provide necessary flexibility for vibration and expansion with offsets and loops, not expansion joints.
- C. Provide flexible connectors at all unit connections.
- D. Replace air in pipe with dry nitrogen to prevent corrosion during soldering.
- E. Install valves, sight glasses, filter-driers, and accessories, furnished by equipment supplier, but not factory installed.
- F. Insulate all underground refrigerant lines with ½" flexible foam.
  1. Use un-slit covering.
  2. Cement all joints.
- G. Hangers:
  1. For insulated piping, provide hangers of size to fit outside insulation.
  2. For non-insulated piping, provide hangers with elastomer insert to prevent damage to piping from vibration.
- H. Testing:
  1. Use the following procedure to test and hydrate the systems:
  2. Isolate any elements which would be damaged by test pressures.
  3. Test system with trace gas using an appropriate leak detector.
  4. Pressure Test - System shall hold 150 psi nitrogen charge for a 24-hour period.
  5. Repair or replace leaking elements of system and re-test.
  6. After system has been proven to be free of leaks, evacuate it with a high efficiency vacuum pump to 2.5 mm of mercury absolute.
  7. Evacuation - System shall be evacuated to 250 microns, and inspected by a University HVAC representative.
  8. Leak the final vacuum by charging with the correct refrigerant.

### 3.3 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. Gas Pipe Testing:
  - 1. Test with air, nitrogen, or carbon dioxide.
  - 2. Test piping system with a pressure 1-1/2 times the proposed maximum working pressure, but not less than 3 psig. Test systems having a volume of 10 cubic feet or less for a period of not less than 10 minutes and larger systems for a period of not less than ½ hour for each 500 cubic foot of pipe volume or fraction thereof without showing any drop in pressure.
  - 3. Fully purge gas piping after piping has been checked.
- J. 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.
- K. 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.

3.4 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:
4. Open valves to full open position. Close coil bypass valves.
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 23 20 00**

## SECTION 23 21 00 - HYDRONIC SYSTEMS

### PART 1 - GENERAL

#### 1.1 SYSTEM DESIGN REQUIREMENTS

- A. Design piping systems with drain valves at low points of piping, bases of vertical risers, and at equipment.
- B. In hydronic systems subject to freezing provide Dowfrost solution or pumped coils.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. Valves:
    - a. Automatic Fill Valves:
      - 1) ITT Bell and Gossett, Model B7-12
      - 2) Amtrol, Model 11F

#### 2.2 MATERIALS, GENERAL

- A. Piping and Fittings:
  - 1. General: Working pressure and temperature maximums, 125 psi and 250 degrees F; water service.
  - 2. Copper Pipe: ASTM B88-96, copper tubing, hard drawn, Type K for underground lines and Type L for above ground lines.
    - a. Fittings: ASME B16.22-95, wrought copper solder joint.
    - b. Joining Material:
      - 1) Solder: ASTM B32-96, 95-5 tin-antimony solder for above ground lines.
      - 2) Brazing: AWS A5.8-92, Classification BAg 1 (silver) for underground lines and where copper pipe is connected to brass.
    - c. Unions: ASME B16.22-95. Wrought copper solder joint, ground seat.
    - d. Flanges: Class 125, cast iron or cast bronze flanges.
      - 1) Bolts and Nuts: ASME B18.2.1-96, carbon steel square head machine bolts with galvanized heavy hex nuts.
      - 2) Gaskets: ASME B16.21-92, nonmetallic, flat, 1/16-inch, full faced, for water service.
    - e. Dielectric Connections: Fittings having insulating material isolating joined dissimilar metals.
      - 1) Dielectric Waterway Fittings: 175 psi minimum working pressure, ends to match connections.
      - 2) Flanges: Class 125, cast bronze, ASME Standard, with bolt insulators, dielectric gasket, bolts, and nuts.
- B. Valves:
  - 1. Safety Relief Valves:
    - a. Brass or bronze body with brass and rubber, wetted, internal working parts. Valves designed, built, rated, and stamped in accordance with ASME.
  - 2. Automatic Fill Valve: Diaphragm operated, cast brass body, fill valve designed to maintain water pressure in a closed water system. Valves shall include cleanable strainer, removable seat assembly, and built-in check valve. Valves shall have factory setting of 12 psig with field



adjustment range of 10 - 25 psig. Maximum operating temperature shall be 225 degrees F, maximum working pressure of 125 psig. Valve shall have 3/4-inch inlet and outlet.

- C. Piping Accessories:
  - 1. Drain Pans: Minimum 18-gauge stainless steel, reinforced to support weight of drain pan and water.

## PART 3 - EXECUTION

### 3.1 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 water piping.
- C. 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.
- D. Install piping in accordance with the stipulations in Section 01040..
- E. 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.
- F. Fittings: Standard manufactured fittings. Field fabricated fittings and bushings are prohibited on all piping.
- G. 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.
- H. Flanges: Install flanges on valves and equipment having 2-1/2-inch and larger connections.
- I. Pipe Ends: Cut pipes, remove burrs and prepare ends with full inside diameter.

- J. 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.
- K. Keep openings in piping closed during construction to prevent entrance of foreign matter.
- L. Install stainless steel flexible connectors at inlet and discharge connections to base-mounted pumps and other vibration producing equipment.
- M. 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.
- N. 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.
  2. Install automatic fill valve in cold water make-up to boilers and chillers. Install three-valve bypass with globe valve around automatic fill valve for quick filling system. Install backflow preventers upstream of fill valve and bypass.
- O. 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.
- P. Expansion Tank and Air Separator Installation:
1. Install tanks as shown; locate appurtenances for easy servicing.
  2. Install gate valve and union on air separator drain to facilitate removal of strainer. Route discharge on air separator tank to nearest drain.
  3. Check expansion tank after cleaning, testing, and filling of system to ensure system is completely full.

4. Provide bracket supports, saddles, and hangers to support tanks.
5. Install air separator level in both directions, supported from structure so that all pipe can be removed without moving tank.
6. Charge expansion tank with proper air charge.

### 3.2 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.

### 3.3 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 23 21 00**

## SECTION 23 21 16 - PIPING SPECIALTIES

### PART 1 - GENERAL

#### 1.1 SYSTEM DESIGN 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. General: 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. Where more than one type is indicated, selection is Installer's option.
- 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.
- D. Shall be made in accordance with Section 23 00 00.

#### 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.
  - 5. ASME "Boiler and Pressure Vessel Code", Section IX, "Welding and Brazing Qualification" for qualifications for welding processes and operators.

### PART 2 - PRODUCTS

#### 2.1 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.
  - c. Hoffman Specialty ITT, Fluid Handling Div.
  - d. Spirax Sarco
2. Pipe Escutcheons:
  - a. Chicago Specialty Mfg. Co.
  - b. Sanitary-Dash Mfg. Co.
  - 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. Combination Pressure and Temperature Relief Valves:
  - a. Amtrol, Inc.
  - b. Bell and Gossett ITT; Fluid Handling Div.
  - c. Watts Regulator Co
  - d. Spirax Sarco
6. Pressure Regulating Valves (Steam Application):
  - a. Spence (preferred)
  - b. Hoffman Specialty ITT; Fluid Div.
  - c. Armstrong.

## 2.2 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. 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.
- D. 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.
- E. 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.
- F. Unions: ANSI B16.39 malleable-iron, Class 150, hexagonal stock, with ball-and- socket joints, metal-to-metal bronze seating surfaces; female threaded ends. Threads shall conform to ANSI B1.20.1.
- G. 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.
- H. Gas Meter:
1. As per local utility supplier.
  2. Coordinate any monitoring of meter with 23 09 00.
- I. Domestic Water Meter:
1. General: Install per local utility.
- J. Vacuum Breakers
1. Armstrong
  2. Watts
  3. Hoffman+
  4. Spirax Sarco

## PART 3 - .EXECUTION

### 3.1 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 1/4" 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.
  13. Dielectric waterway fittings: Install at each piping joint between ferrous and non-ferrous piping. Comply with manufacturer's installation instructions.
  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 23 21 16**

## SECTION 23 30 00 - HVAC AIR DISTRIBUTION

### PART 1 - GENERAL

#### 1.1 SYSTEM DESIGN REQUIREMENTS

##### A. Ductwork:

1. Fiberglass ductwork is not permitted.
2. Designer should evaluate cost effective means to achieve sound alleviation in the ductwork or at the air-handling unit.
3. Ductwork used in humidification systems to be stainless steel.
4. All exhaust ductwork used in animal housing areas to be welded stainless steel.
5. All exhaust ductwork in A/BSL-3 applications to be welded stainless steel.
6. Supply air ductwork between fan and terminal boxes (medium and high): Galvanized steel, (Grade G90 or better) shop fabricated rectangular, spiral, round or oval factory fabricated.
7. Rectangular supply air ductwork from discharge or terminal box to air devices (low pressure): Galvanized sheet metal (lined where noted on drawings); factory or shop fabricated.
8. Return air ductwork: Galvanized Steel (lined where noted on drawings): factory or shop fabricated.
9. General building exhaust ductwork: Galvanized sheet metal (lined as noted on drawings); factory or shop fabricated.
10. Transfer Ducts: Internally lined galvanized sheet metal as described above for low-pressure supplies; factory or shop fabricated.
11. Sound elbows for R.A. grilles: Galvanized sheet metal (internally lined).
12. Radioisotope exhaust ductwork: 304 stainless steel all welded construction; factory or shop fabricated.
13. Laboratory ductwork: Unlined galvanized or stainless steel ductwork as required by lab service.
14. Duct sizes on drawings shall be outside sheet metal dimensions.
15. Pressure Classifications:
  - a. Low Pressure: Three pressure classifications: 1/2 inch WG positive or negative static pressure and velocities less than 2,000 fpm; 1 inch WG positive or negative static pressure and velocities less than 2,500 fpm and 2 inch WG positive or negative static pressure and velocities less than 2,500 fpm.
  - b. Medium Pressure: Three pressure classifications: 3 inch WG positive or negative static pressure and velocity less than 4,000 fpm, 4 inch WG positive static pressure and velocities greater than 2,000 fpm, 6 inch WG positive static pressure and velocities greater than 2,000 fpm.
  - c. High Pressure: Positive static pressure over 6 inches WG and less than 10 inches WG and velocities greater than 2,000 fpm.
16. Air Leakage:
  - a. Pressure testing of ductwork in the 3-inch and higher Duct Pressure Class is required..

##### B. Duct Accessories:

1. Volume Control Dampers:
  - a. Show all required locations for volume control dampers in the ductwork required for air balancing. Main ducts, branch ducts, and zone ducts must have dampers to permit proper division of air quantities. Each supply branch and outlet, and each exhaust branch must have a damper control. Parallel and opposed-blade dampers shall have 4 diameters of straight duct downstream of damper. Avoid locating dampers where it is obvious they won't be needed because of the inherent pressure drops in the system due to duct layout, longest run, etc.
  - b. Do not install a volume damper with a frame that protrudes into an airstream due to excessive noise and pressure drop.



- c. Provide locking, indicating quadrant regulators on volume control dampers.
      - d. Dampers that are integral parts of supply or exhaust diffusers or grilles are not permitted for balancing. Provide dampers at branches or takeoffs for balancing.
    - 2. Take-offs:
      - a. Provide conical take-offs with a manual damper if warranted. If the main duct is not deep enough for a conical fitting, specify a 45 degree fitting with a round collar.
      - b. Do not put manual dampers in take-offs to VAV terminals.
  - C. Air Filtration and Cleaning Devices:
    - 1. Filter all air supplied to the building. Main building ventilation systems shall filter the air at central filter banks. Central filter banks shall have pre-filters
    - 2. Varicel and HEPA filters shall be accessible for either upstream or downstream servicing. Pleated panel filters shall be removable from the upstream side without disturbing the filters.
    - 3. Provide magnehelic gauges on all air handling unit filter banks.
    - 4. Exhaust air systems, which have filters for protection of heat recovery coils, shall be 4 inch MERV 7 filters. Filters shall be easily accessible and removable through side access frames.
    - 5. All filter doors and frames (when applicable) shall utilize closed-coil gasketing.
    - 6. Provide extended surface high efficiency media filters where the filtering of biological organisms is required.
    - 7. Provide activated carbon filters where odor control is required.
    - 8. Provide filters upstream of all coils.
  - D. Air Terminal Devices:
    - 1. All air flow dampers need to be far enough away from the heating coil to ensure proper heating of the air at minimum flows.
    - 2. Design systems to minimize maintenance or service requirements in occupied spaces.
    - 3. Provide aspirating air outlets to prevent dumping of air into occupied spaces at minimal air volumes.
    - 4. Design system flexibility to revise zoning with minimal changes in ductwork and controls.
    - 5. Air terminal units to be used in a healthcare, clean room or lab facility shall have a special VAV unit liner to meet health care facility standards. No exposed fiberglass in the airstream.
    - 6. The use of fan powered VAV terminals is discouraged. Discuss application of fan powered terminals and other night low limit strategies with the University Project Manager.
    - 7. Provide manufacturer's required upstream straight distances before airflow station.
    - 8. Provide access panels up and downstream of reheat coils.
  - E. Building Air Inlets and Outlets:
    - 1. In buildings where exhaust air may be contaminated, locate the building air supply intake to avoid recirculation of the building exhaust air.
    - 2. Provide air intake louvers in vertical position with a face velocity and arrangement to mitigate snow intake. Provide 1/2-inch bird screen. Maximum velocity of 500 FPM face velocity.
    - 3. Locate air intakes as high as possible above grade. Locate bottom of air intakes minimum 20' above grade.
  - F. Diffusers, Registers, Grilles:
    - 1. Indicate provisions for balancing airflow from outlets or into inlets on the drawings.
    - 2. Provide for quantities and distribution patterns as shown on the drawings.
- 1.2 SUBMITTALS
- 1. 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.
- 2. Submit diffuser, register, and grille performance characteristics including, CFM ratings, pressure drops, NC levels, and throw patterns.
- 3. Submit louver color samples for selection and approval.
- 4. Submit duct access door coordination drawing for approval.

### 1.3 QUALITY ASSURANCE

- A. SMACNA Standards:
  - 1. Comply with SMACNA's "HVAC Duct Construction Standards, second edition".
  - 2. Comply with 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.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. Balance Dampers:
    - a. Greenheck
    - b. Ruskin
    - c. Pottorff
  - 2. Ductwork:
    - a. Hercules
    - b. Shop fabricated.
  - 3. Grilles, Registers and Diffusers:
    - a. Metalaire
    - b. Titus
    - c. Price
    - d. Nailor
  - 4. Louvers:
    - a. Greenheck
    - b. American Warming/Air Balance
    - c. Ruskin

### 2.2 MATERIALS, GENERAL

- A. Ductwork:
  - 1. Galvanized Ducts: Lock-forming quality, ASTM A527, Coating designation G 90. 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.
  - 2. Aluminum Ducts: ANSI/ASTM B209; aluminum sheet, alloy 3003, Temper H14. Aluminum connectors and bar stock shall be Alloy 6061-T6 or equivalent strength.

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 Fan Connections: Fabricate in accordance with SMACNA Low Pressure Duct Construction Standards. UL 181 fire-resistant, neoprene coated, woven glass fiber fabric, minimum 30 oz. per square yard, crimped into metal edging strip. Suitable for 1-1/2 times duct pressure at connection. Outside flexible duct connectors shall be rated for outdoor use.
  6. 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, 3/4 pound insulation and aluminized vapor barrier.
  7. 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.
    - a.
  3. Spare Parts: Refer to Section 01 78 46 – Extra Stock Materials.
- C. Air Inlets and Outlets:
1. Louvers:
    - a. Test and rate performance in accordance with AMCA 500.
    - b. Stationary Steel Louver: 16 gauge galvanized steel louver with 4-inch storm proof and drainable blades on 4-inch centers at 45 degree angle and channel mounted in extruded aluminum rewirable frame. frame construction with storm proof blades. Provide aluminum bird screen.
    - c. Stationary Aluminum Louver: Extruded aluminum, 0.081 inch thick louver with 4-inch storm type blades with 5-inch spacing at 45 degree angle with storm proof and drainable blades. Head, sills, and jambs to be one piece extruded structural members. Fastenings shall be either stainless steel or aluminum. Fixed blade accurately fitted and firmly secured to frames. Provide aluminum bird screen mounted in extruded aluminum rewirable frame.
- D. Grilles, Registers, and Diffusers:

1. General:
  - a. Test and rate performance in accordance with 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. 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.
3. Grilles:
  - a. Wall Grilles: 45-degree deflection, 3/4-inch blade spacing, steel grille with front blades parallel to long dimension. Grille finish shall be white.

### PART 3 - EXECUTION

#### 3.1 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 schedule of operating pressures as shown on drawings.
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.
7. Electrical Equipment Spaces: Do not route ductwork through transformer vaults and their electrical equipment spaces and enclosures.

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.

F. Filters:

1. Install bag-in/bag-out filters at location shown on drawings. Housing shall be labeled "Danger, Hazardous Material". Install housing in accordance with manufacturer's instructions and allow a minimum 36" clearance for access.

3.2 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.
  - 3. Test Failures: Duct systems shall be repaired if test pressure and leakage requirements are not met or if air noise condition is encountered. Repairs and sealing shall be done with sheet metal, tape, sealant, or a combination thereof.
- D. Fire and Smoke Damper:
  - 1. Dampers shall be tested and accepted in accordance with NFPA prior to project closeout.
- E. 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 23 30 00**

## SECTION 23 40 00 - HVAC FANS

### PART 1 - GENERAL

#### 1.1 DESIGN REQUIREMENTS

##### A. Exhaust Systems:

1. Exhaust systems that may transport offensive odors, noxious gases, etc., are to be separate systems. Provide identifying labels on exterior stacks per the instructions of the Project Manager.
2. Locate fans so that negative pressure exists in all exhaust ducts within buildings.
3. Conditioned make-up air shall be provided to compensate for exhaust.
4. Recirculation systems are not allowed in laboratory spaces.
5. Refer to Section 23 00 00 for Special HVAC Systems including lab exhaust systems.
6. Lab exhaust systems to utilize utility set fans, with exhaust stacks. Design of exhaust stack to be justified per AHRAE design requirements, or via a wind/wake analysis. Use of high-plume dispersion type fans are at the approval of the university project manager.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

##### A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Fans:
  - a. Acme
  - b. New York Blower
  - c. Greenheck
  - d. MK Plastics – Reference 1.1
  - e. Cook
  - f. Twin Cities

#### 2.2 MATERIALS, GENERAL

##### A. Centrifugal Fans:

1. Unit Casing: Galvanized steel panels, formed and reinforced, seams continuously welded. All interior and exterior surface steel shall be coated with a minimum of 2-4 mils of Polyester Urethane, electrostatically applied and baked. No uncoated metal fan parts will be allowed. Provide access doors or panels to allow access to internal parts and components.
2. Fan Wheel: Non-overloading single width airfoil centrifugal type. Wheels shall be statically and dynamically balanced to balance grade G6.3 per ANSI S2.19. Fan wheel shall be manufactured with continuously welded steel airfoils and coated with a minimum of 2-4 mils of Polyester Urethane, electrostatically applied and baked
3. Shaft: Turned, ground, polished, and rust protected steel. Designed to operate at no more than 70 percent of the first critical speed at the top of the fan's speed range.
4. Shaft Bearings: Air handling quality self-aligning, heavy duty, pillow block type, roller or ball type bearings with L10 rated bearing life of 80,000 operating hours. Provide extended lube lines.
5. Belt Drives: V-belt drives rated at not less than 200% of motor nameplate rating. Belt speeds shall not exceed 4500 feet per minute. Center distances between driver and driven sheaves must meet the manufacturer's minimum and maximum. Belts shall be notched AX, BX or CX series.
6. Sheaves: All sheaves shall be fixed pitch type. Variable pitch sheaves are not permitted. Fixed pitched sheaves supplied with units shall be replaceable by fixed pitched sheaves for balancing purposes. No sheave shall be less than 3.9 inch PD
7. All accessible inlet or exhaust openings in fans shall have 1/2 inch square wire mesh guards covering those openings as well as belt and pulley guards.

8. Motor nameplate to include stamped bearing size.
9. All large motors will have double pull, adjustable motor mounts.
10. Size fans to provide design airflow at 15% below maximum rpm as suggested by the manufacturer.
11. Motors: Reference 23 05 13 Motors for more information.
12. Belt Guard: Fabricated to OSHA and SMACNA requirements.
13. Accessories:
  - a. Scroll access doors shaped to conform to scroll with quick-opening latches and gaskets.
  - b. Galvanized steel companion flanges for duct connections.
  - c. 2-inch drain connections.
  - d. Removable inlet and outlet safety screens for access to fan for maintenance.

B. Wall Ventilators:

1. Housing: Weatherproof, heavy-gauge spun aluminum with rigid steel internal support structure.
2. Fan Wheel: Aluminum, non-overloading, backward inclined, centrifugal type. Dynamically balanced.
3. Motor: Open drip proof, high-efficiency motor, mounted out of the air stream. Reference 23 05 13 Motors for more information.
4. Shafts: Solid steel, precision ground, polished, and treated for rust resistance.
5. Drive:
  - a. Belt drive:
    - 1) Bearings: Heavy duty, with L-10 rated bearing-life exceeding 80,000 operating hours.

2.3 QUALITY ASSURANCE

A. Codes, Regulations and Standards: Comply with the following:

B. Wall Ventilators:

1. Housing: Weatherproof, heavy-gauge spun aluminum with rigid steel internal support structure.
2. Fan Wheel: Aluminum, non-overloading, backward inclined, centrifugal type. Dynamically balanced.
3. Motor: Open drip proof, high-efficiency motor, mounted out of the air stream. Reference 23 05 13 Motors for more information.
4. Shafts: Solid steel, precision ground, polished, and treated for rust resistance.
5. Drive:
  - a. Belt drive:
    - 1) Bearings: Heavy duty, with L-10 rated bearing-life exceeding 200,000 operating hours.
    - 2) Pulleys: Cast iron fixed pitch, sized for 150 percent of the driven horsepower.
6. Vibration Isolators: Multidirectional, rubber-in-shear.
7. Screen: Aluminum bird screen.
8. Roof Curb:
  - a. Field-built.
  - b. Prefabricated, galvanized curb with welded seams and fastening flange for "self-flashing". Closed cell neoprene rubber gasketing around the top of the curb and 1-1/2-inch thick, 3-pound density rigid insulation along the sides. Curbs shall be minimum 14" high.
9. Nameplate: Each fan shall bear a permanently affixed manufacturer's nameplate containing the model number and individual serial number for future identification.
10. Accessories:
  - a. Hinged Sub-base: Rust-proof hinge arrangement permits access to curb well for access to curb mounted dampers.
  - b. Backdraft damper: Galvanized steel frame, multi-leaf, roll formed aluminum blades with nylon bearings.



- C. Upblast Roof Ventilators:
1. Housing: Heavy-gauge spun aluminum housing with rigid steel internal support structure, spun aluminum windband, and aluminum base with continuously welded curb cap corners.
  2. Fan Wheel: Aluminum, non-overloading, backward inclined, centrifugal type. Dynamically balanced.
  3. Motor: Heavy duty type, permanently lubricated, sealed ball bearing, open drip proof, high-efficiency motor, mounted out of the air stream. Reference 23 05 13 Motors for more information.
  4. Shafts: Solid steel, turned, ground, and polished.
  5. Drive:
    - a. Belt drive, cast iron, keyed and securely attached to wheel and motor shafts:
      - 1) Bearings: Heavy duty, greasable ball type mounted in cast iron housing, L10 rated 100,000 operating hours.
      - 2) Pulleys: Fixed pitch, sized for 150 percent of the driven horsepower.
  6. Vibration Isolators: Multidirectional, rubber-in-shear.
  7. Screen: Aluminum bird screen.
  8. Roof Curb:
    - a. Field-built.
    - b. Prefabricated, galvanized curb with welded seams and fastening flange for "self-flashing". Closed cell neoprene rubber gasketing around the top of the curb and 1-1/2-inch thick, 3 pound-density rigid insulation along the sides.
  9. Accessories:
    - a. Hinged Sub-base: Rust-proof hinge arrangement permits access to curb well for access to curb mounted dampers.
    - b. Backdraft damper: Galvanized steel frame, multi-leaf, roll formed aluminum blades with nylon bearings. Motorized Actuator.
    - c. Provide fans with UL-762 listing for all grease applications.

**END OF SECTION 23 40 00**

## SECTION 23 70 00 - CENTRAL HVAC EQUIPMENT

### PART 1 - GENERAL

#### 1.1 DESIGN REQUIREMENTS

- A. General:
  - 1. Locate roof-mounted equipment as inconspicuous as possible by placing equipment far away from edge of roof, painting, screening or a combination of these,
  - 2. Locate fans, motors, and drives for safe and easy access for periodic inspection and maintenance.
  - 3. Show air handling unit arrangements on schematic diagrams.
  - 4. Scheduled fan sound ratings where noise levels are critical.
  - 5. All fans shall be licensed to bear the AMCA Seals for Air and Sound Performance.
- B. Fan specifications and accessories for all fans 12 inch and larger wheel shall include the following.
  - 1. Direct drive fans are preferred.
  - 2. Provide building air handling unit fans with external bearings only. Shafts 3/4 inches and larger shall have roller bearings. No internal bearings recessed into fan housing shall be allowed. All bearings shall be accessible for lubrication, maintenance, and replacement.
  - 3. Aluminum wheels are not allowed except for spark proof applications.
  - 4. Install weatherproof housing over motor and drive when exposed to weather. Metal interior casings and wheels shall be coated if fumes are corrosive.
- C. Fan Vibration Isolation:
  - 1. Provide spring isolators either within the air handling unit housing or independently mounted to reduce the transmission of distributing vibration of the fan to the supporting structure by a minimum of 90%.
- D. Drives:
  - 1. Single belt drives shall be utilized only on equipment with 1 Hp motors or less.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers:
  - 1. Fan Coil Units:
    - a. McQuay
    - b. Hitachi
    - c. International Environmental

### PART 3 - EXECUTION

#### 3.1 INSTALLATION, GENERAL:

- A. Install equipment such that filters, motors, bearings, and belts can be easily serviced.
- B. Install filters prior to starting fans.
- C. Connections:

1. Connect piping to air handling units with flexible connectors.
  2. Connect drain piping to condensate drain pans with deep trap. Route piping to nearest floor drain. Install cleanouts at changes in direction.
  3. Install flexible connections at inlet and outlet of fans connected to ductwork.
- D. Locate motor disconnect within 3 feet of the motor.
- E. Fan Drive:
1. Align belts with proper tension prior to start-up.
  2. Final sheave shall be fixed. Balancing firm's variable sheaves will be removed and replaced with the proper sized fixed sheaves.
  3. Original sheaves shall be changed when required for proper balancing.
- F. Fans:
1. Access shall be provided to allow cleaning of fan and blades without disassembling ductwork
  2. Install fans in accordance with manufacturer's printed data. Prior to starting fan, clean ductwork and lubricate bearings.
- 3.2 TESTING, CLEANING, AND CERTIFICATION
- A. Clean fan interiors. Vacuum clean fan wheels, cabinets, and coils entering air face.
- B. Provide one (1) new set of filters to be installed by contractor at the time of system acceptance.
- 3.3 COMMISSIONING (DEMONSTRATION)
- A. Provide 2 hours of operating instructions for each fan and air handling unit. Include procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance. Review data in the operation and maintenance manuals.

**END OF SECTION 23 70 00**

## SECTION 26 05 00 - COMMON WORK RESULTS FOR ELECTRICAL

### PART 1 - GENERAL

#### 1.1 DESIGN REQUIREMENTS

#### 1.2 DEFINITIONS

- A. Refer to Article 100 of the currently adopted National Electrical Code for definitions as applicable to this project.
- B. Other definitions:
  - 1. "Concealed": Embedded in masonry, concrete or other construction, installed in furred spaces, within double partitions or hung ceilings, in trenches, in crawl spaces, or in enclosures.
  - 2. "Exposed": Not installed underground or "concealed" as defined above.
  - 3. "Furnish" or "Provide": To supply, install and connect up complete and ready for safe and regular operation of particular work unless specifically otherwise noted.
  - 4. "Install": To erect, mount and connect complete with related accessories.
  - 5. "Indicated", "Shown" or "Noted": As indicated, shown or noted on drawings or specifications.
  - 6. "Related Work" includes, but is not necessarily limited to, mentioned work associated with, or affected by, the work specified.
  - 7. "Reviewed", "Satisfactory", "Accepted", or "Directed": As reviewed, satisfactory, accepted, or directed by or to Engineer.
  - 8. "Similar": Equal in materials, weight, size, design, construction, capacity, performance, and efficiency of specified product.
  - 9. "Supply": To purchase, procure, acquire and deliver complete with related accessories.
  - 10. "Wiring": Raceway, fittings, wire, boxes and related items.

#### 1.3 SUBMITTALS

- A. Submittals shall be made in accordance with General Conditions of Contract and the requirements of Section 01 33 00.
- B. Shop drawings shall include equipment catalog cuts or manufacturer's printed data identifying: dimensions, weights, recess openings, equipment arrangements, electrical characteristics with bus size, electrical rating, material, wiring diagrams indicating circuit arrangement and NEMA rating for, but not limited to the following:
  - 1. Panel boards
  - 2. Wiring Devices
  - 3. Interior and Exterior Lighting
  - 4. Hangers and Supports for Electrical Systems
  - 5. Grounding and Bonding
  - 6. Fire Detection and Alarm
- C. Submit composite coordination drawings to include location and routing of the electrical system components in relation to the mechanical ducts, piping and structural beams.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: All electrical work at the University shall be performed by a State of Colorado licensed contractor under the supervision of a licensed electrician. Contractors shall verify that electricians are currently licensed by the State of Colorado and shall supply Project Manager with names

and license numbers. Contractor shall have a minimum of 3 years of satisfactory performance in conducting the type of work specified.

1. ANSI/NFPA 70 - National Electrical Code.
2. ANSI/IEEE C2 - National Electrical Safety Code.
3. NECA - Standard of Installation.
4. NFPA – National Fire Protection Association.
5. IEEE – The Institute of Electrical and Electronics Engineers.
6. NEMA – National Electrical Manufacturer Association.
7. International Building Code in accordance with the Campus Building Official.
8. ASTM - American Society of Testing Materials
9. IPCEA - Insulated Power Cable Engineers Association
10. Underwriter's Laboratories (UL)
11. American National Standards Institute (ANSI)
12. Other requirements as listed elsewhere in these specifications.

- B. The drawings and specifications take precedence when they are more stringent than codes, statutes, or ordinances in effect. Applicable codes, ordinances, standards and statutes take precedence when they are more stringent than, or conflict with the drawings and specifications.

C. Record Documents:

1. Maintain a separate set of contract electrical drawings at the site in accordance with Section 01 74 00 to show the following:
  - a. Major raceway systems, size and location, for both exterior and interior; locations of control devices; distribution and branch electrical circuitry; and fuse and circuit breaker size and arrangements.
  - b. All branch circuits, feeders, communications conduits embedded in concrete, dimensioned from prominent building lines.
  - c. Equipment locations (exposed and concealed) dimensioned from prominent building lines.
  - d. Approved substitutions, Contract Modifications, and actual equipment and materials installed.

D. Operations and Maintenance Data:

1. O and M Data shall be provided in accordance with Section 01 78 23 including the following information:
  - a. Description of function, normal operating characteristics and limitations, fuse curves, engineering data and tests, and complete nomenclature and commercial numbers of all replaceable parts.
  - b. Manufacturer's printed operating procedures to include start-up, break-in, routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
  - c. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
  - d. Servicing instructions and lubrication charts and schedules.
  - e. Complete list of parts and wiring diagrams.
  - f. Names, addresses and telephone numbers of the Contractor, Sub-contractors and local company responsible for maintenance of each system or piece of equipment.
  - g. All information shall be permanently bound in a 3-ring binder. The job name and address, and Contractor's name and address shall be placed on the cover and spine of each binder in a permanent manner. Dymo-tape is not acceptable.
  - h. Copies of all test reports shall be included in the manuals.

## 1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store and handle products in accordance with manufacturer's instructions, and the requirements of Section 01 10 00.

#### 1.6 WARRANTY

- A. All electrical equipment, materials and workmanship warranties shall be provided in accordance with the requirements of Section 01 78 36 and the following:
  - 1. The Contractor warrants the electrical system, material and workmanship, for a period of one year from the date of the University final acceptance of the installation unless as otherwise noted in Commissioning.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS, GENERAL

- A. All equipment and materials installed shall be new, unless otherwise specified. Defective or damaged materials shall be replaced or repaired, prior to final acceptance, in a manner acceptable to the Engineer or The university and at no additional cost to the University.
- B. All electrical materials shall be acceptable for installation only if labeled or listed UL and, if accepted, by the authority having jurisdiction.
- C. All major equipment components shall have the manufacturer's name, address, model number, and serial number permanently attached in a conspicuous location.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION, GENERAL

- A. Construct Work in sequence under provisions of Division 1 where applicable.
- B. Electrical Contractor shall coordinate Divisions 26, 27, and 28 work with the installer of Division 21, 22 and 23 and other work to ensure that code required clearances relating to space required for access to electrical equipment is properly maintained.
- C. Install Work using procedures defined in NECA Standard of Installation.
- D. Workmanship shall conform to highest industry standards for each trade involved in installation of the Work.
- E. Upon completion of work, all equipment and materials shall be installed complete, thoroughly checked, correctly adjusted, and left ready for intended use or operation. All work shall be thoroughly cleaned and all residues shall be removed from surfaces.
- F. Exterior surfaces of all material and equipment shall be delivered in a perfect, unblemished condition.
- G. Carefully lay out all work in advance so as to eliminate where possible, cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings and roofs. Any damage to the building, structure, piping, ducts, equipment or any defaced finish shall be repaired by skilled mechanics of the trades involved at no additional cost to the University.
- H. All openings made in fire-rated walls, floors, or ceilings shall be patched and made tight in a manner to conform to the fire rating for the surface penetrated. Paint to match surface when visible.

- I. All penetrations required through completed concrete construction shall be core drilled at minimum size required. Precautions shall be taken when drilling to prevent damage to structural concrete. The Contractor shall obtain permission from the Architect and Structural engineer before proceeding with drilling.
- J. Sleeve Seals: Provide sleeve seals for penetrations located in foundation walls below grade, or in exterior walls, of one of the following:
  - 1. Caulk between sleeve and raceway with approved Caulk material.
  - 2. Mechanical Sleeve Seals: Modular mechanical type, as manufactured by Thunder line Corp., consisting of interlocking synthetic rubber links shaped to continuously fill annular space between raceway and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal.
- K. 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 according to the National Electric code and the AHJ.
- L. Extend all conduits so that junction and pull boxes are in accessible locations.
- M. Install access panel or doors where equipment or boxes are concealed behind finished surfaces in areas such as restrooms. These access doors shall be a minimum of twenty by twenty inches or as required to accommodate full pull box or equipment access.
- N. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- O. Electrical system layouts indicated on drawings are generally diagrammatic but shall be followed as closely as actual construction and work of other trades will permit. Govern exact routing of raceways and locations of outlets by structure and equipment served. Take all dimensions from engineering drawings.
- P. Consult all other drawings. Verify all scales and report any dimensional discrepancies or other conflicts to Engineer before submitting bid.
- Q. Furnish and install all necessary hardware, hangers, blocking, brackets, bracing, runners, etc. required for equipment specified under this Division.
- R. Remove all unused or abandoned conduit, junction boxes, panels, and other electrical components back to the source.
- S. Provide all power feeds and final connections to motors and other electric equipment furnished under Divisions 21, 22, and 23.
  - 1. Install and wire through all control devices which directly handle full load motor or electric heating equipment current, such as magnetic starters, line voltage thermostats, P.E. switches, etc. which are furnished by Electrical Contractor. Located where shown on the electrical drawings.
  - 2. Provide disconnects for all mechanical equipment as indicated on project drawings.
  - 3. Provide all power and control wiring which directly handles full load current of motors or electric heating equipment.

### 3.2 TESTING, CLEANING AND CERTIFICATION

- A. Operating and Acceptance Tests: Provide all labor, instruments, and equipment for the performance of tests as specified below and elsewhere in these specifications.
  - 1. Perform a careful inspection of the main switchboard bus structure and cable connections to verify that all connections are mechanically and electrically tight.
  - 2. For a one-day period after the remodeled area has been placed into normal service, record the full load current in each phase or each line at the panel bus and submit to the Engineer.
- B. Clean-Up: Remove all materials, scrap, etc., relative to the electrical installation, and leave the premises and all equipment, lamps, fixtures, etc. in a clean, orderly condition. Any costs to the University for clean up of the site will be charged against the Contractor.

### 3.3 COMMISSIONING (DEMONSTRATION)

- A. Acceptance Demonstration: Upon completion of the work, at a time to be designated, the Contractor shall demonstrate for the University the operation of the entire installation, including all systems provided under this contract.
- B. The Contractor shall furnish the services of a qualified representative of the supplier of each item or system who shall instruct specific personnel, as designated by the University, in the operation and maintenance of that item or system.
  - 1. Instruction shall be given when the particular system is complete, and shall be of the number of hours indicated. A representative of the Contractor shall be present for all demonstrations.

**END OF SECTION 26 05 00**



## **SECTION 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES**

### **PART 1 - GENERAL**

#### **1.1 SUBMITTALS**

- A. Product data shall be submitted for in accordance with the requirements of Section 26 05 00 each of the following:
  - 1. Wires
  - 2. Cables
  - 3. Connectors

#### **1.2 QUALITY ASSURANCE**

- A. Wire and cable shall be provided and installed in accordance with the requirements of Section 26 05 00.
- B. Installer Qualifications and Certifications: Firms with at least 3 years of successful installation experience with projects utilizing electrical wiring cabling work similar to that required for this project.
- C. Regulatory Requirements: Conform to applicable code relations regarding toxicity of combustion products of insulating materials
- D. 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.

#### **1.3 DELIVERY, STORAGE, AND HANDLING**

- A. Wire and cable shall be delivered, stored and handled in accordance with the requirements of Section 26 05 00.
- B. Deliver wire and cable properly packaged in factory-fabricated type containers, or wound on NEMA-specified type wire and cable reels.
- C. Store wire and cable in clean dry space in original containers. Protect products from weather, damaging fumes, construction debris and traffic.
- D. 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.

#### **1.4 WARRANTY**

- A. Wire and cable warranties shall be provided in accordance with the requirements of Section 26 05 00.

### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by the following (for each type of wire, cable, and connector):
  - 1. Wire and cable:
    - a. Triangle - PWC

- b. American Wire and Cable Co.
- c. Anaconda-Ericsson Inc; Wire and Cable Div.
- d. Belden Div; Cooper Industries
- e. General Cable Corporation
- f. General Electric
- g. Okonite
- 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 MATERIALS, GENERAL

- A. Wires and Cables:
  - 1. Provide new wire and cable suitable for the temperature, conditions, and location where installed. All cable shall be new and shall conform to or exceed IPCEA requirements. Building wire shall be insulated with THHN/THWN insulation, rated 600 volt.
  - 2. Conductors: Provide solid conductors for power and lighting circuits 12 AWG and smaller. Provide stranded conductors for 10 AWG THHN/THWN and larger. In sizes 250 MCM and larger use type THW or THWN. In sizes #1 AWG and smaller all conductors shall have heat/moisture resistant thermoplastic insulation type THW or THWN (75 degree C), except as follows:
  - 3. Conductor Material: Provide copper for all wires and cables.
  - 4. Metal Clad cable is acceptable.
  - 5. Use colors of wires as specified in paragraph 3.5 of this section.
  - 6. For general applications, other than special use, use THHN/THWN insulated wire.
  - 7. Use copper wire only.
  - 8. No wire splices shall be allowed in the conduit or conduit fittings. All splices shall be done in an approved box.
  - 9. Grounding conductors shall be copper type THHN/THWN with green integrally-colored insulation, sized to meet NEC.
- B. Connectors:
  - 1. Provide UL type factory-fabricated, solder less 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.
- C. Wire Connectors:
  - 1. For wires size #8 AWG and smaller, insulated pressure type (with live spring) rated 105 degree C, 600 volt, for building wiring and 1000 volt in signs or fixtures. 3M or Ideal.
  - 2. For wires size #6 AWG and larger, T & B or equivalent compression type with 3M #33 or #88 tape insulation.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that mechanical work likely to damage cable has been completed.

### 3.2 INSTALLATION, GENERAL

- A. 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. Pull no wire into any portion of conduit system until all construction work, which might damage the wire, has been completed.
- C. Wires and Cables:
  - 1. 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. Do not exceed manufacturer's tension requirements.
  - 2. Keep conductor splices to minimum. Install all wire continuous from outlet to outlet or terminal to terminal. Splices in cables when required shall be made in hand holes, pull boxes, or junction boxes and shall be in strict accordance with cable manufacturer's recommendations utilizing solder less connectors NEMA/UL approved for the use. Splice only in accessible junction boxes. Use splices and tap connectors which are compatible with conductor material.
  - 3. Install splices and tapes, which possess equivalent or better mechanical strength and insulation ratings than conductors being spliced.
  - 4. Tighten electrical connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values. Where manufacturer's torque requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standard 486 for copper.
  - 5. Support cables above accessible ceilings, do not rest on ceiling tiles. Use spring clips and hanger rods, bridle rings or 'J' hooks, independent from the ceiling suspension system to support cables from structure.
  - 6. Provide adequate length of conductors within electrical enclosures and form the conductors to terminal points with no excess. Bundle multiple conductors, with conductors larger than 10 AWG cables to individual circuits. Make terminations so there is no bare conductor at the terminal.
  - 7. Make up splices in outlet boxes with 8-inch minimum of correctly color-coded tails left in box. Splices in wires size #8 AWG and smaller shall be made with insulated spring type wire connectors, "Scotchlok" or equivalent. Splices in larger wire and cables shall be made with indent connectors NEMA/UL approved for the purpose.
  - 8. Thoroughly tape the ends of spare conductors in boxes and cabinets.
  - 9. Install exposed cable, parallel and perpendicular to surfaces, or exposed structural member, and follow surface contours, where possible.
  - 10. 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.
  - 11. All splices in control panels, terminal junction boxes, low voltage control circuits and fire alarm conductors shall be on numbered terminal strip.
  - 12. When routed in a wall, install all thermostat wire, fire alarm, computer cable, low voltage cable, and other communication cable in conduit.
  - 13. All junction boxes shall be fully accessible.
  - 14. All wiring shall be routed through an acceptable raceway regardless of voltage application, unless specified otherwise under other sections of these standards.

### 3.3 TESTING, CLEANING AND CERTIFICATION

- A. Refer to Section 26 05 00 for testing, cleaning, and certification requirements.
- B. Prior to energizing circuitry, check installed wires and cables with megaohm 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.

- C. Prior to energizing, test wires and cables for electrical continuity and for short-circuits.
- D. Subsequent to wire and cable hook-up, energize circuitry and demonstrate functioning in accordance with requirements. Where necessary, correct malfunctioning units, and then retest to demonstrate compliance.

### 3.4 COMMISSIONING (DEMONSTRATION)

### 3.5 SCHEDULES

- A. Color code secondary service, feeder, and branch circuit conductors as follows:

120/240 Volts	Phase	277/480 Volts
Black	A	Brown
Red	B	Orange
Blue	C	Yellow
White	Neutral	Gray
Green	Ground	Green
Switch leg - Pink		
3 & 4 way travelers - Purple		

- B. Conductors shall be solid color for entire length.
- C. EXCEPTION:
  - 1. Conductors 8 AWG and larger may be black and shall be with color-coded at each termination and in each box or enclosure. For a distance of 6 inches use half-lapped 3/4 inch plastic tape in the specified color. Do not cover cable identification markings. Adjust tape locations to prevent covering of markings.

**END OF SECTION 26 05 19**

**SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS**

**PART 1 - EXECUTION**

**1.1 INSTALLATION, GENERAL**

- A. Provide a separate insulated equipment-grounding conductor in all feeders. Terminate each ground conductor to the bushing and ground lug.
- B. All grounding materials shall be copper with the exception of ground rod, which may be copper clad steel.
- C. Grounding and Bonding for Communications Systems. Provide code-sized ground cable bonding jumpers, installed with ground clamps, across all conduit expansion couplings and fittings.
- D. Provide a corrosion-resistant finish to field connections, buried metallic bonding products, and where factory applied protective coatings have been destroyed, where subject to corrosive action.
- E. Provide an equipment-grounding conductor in all nonmetallic and flexible conduits.
- F. Provide equipment-grounding conductor in all branch circuits. Route to switches, receptacles, equipment enclosures, equipment, and panels etc. and ground as required.
- G. Use mechanical grounding connectors for all grounding connections. Exothermic welded connections may be used underground or to building steel.
- H. Provide a separate insulated equipment-grounding conductor in feeder and branch circuits. Terminate each end on a grounding lug, buss or bushing.
- I. Provide grounding bushings and bonding jumpers for all conduits terminating in reducing washers, concentric, eccentric or oversized knockouts at panel boards, cabinets, and gutters.
- J. Provide bonding wire in all flexible conduits.

**END OF SECTION 26 05 26**

## SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

### PART 1 - PRODUCTS

#### 1.1 MATERIALS, GENERAL

- A. Conduit Hangers: Galvanized steel with special accessories for purpose and adequate to support load imposed.
- B. Coatings: Supports, support hardware, and fasteners shall be protected with zinc coating or with treatment of equivalent corrosion resistance-using NEMA/UL approved alternative treatment, finish, or inherent material characteristic. Products for use outdoors shall be hot-dip galvanized.
- C. Raceway Supports: Clevis hangers, riser clamps, conduit straps, threaded C-clamps with retainers, ceiling trapeze hangers, and wall brackets.
- D. Fasteners: Types, materials, and construction features as follows:
  - 1. Expansion Anchors: Carbon steel wedge or sleeve type.
  - 2. Toggle Bolts: All steel springhead type.
- E. 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.
- F. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for no 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.
- G. U-Channel Systems: 16-gauge 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.
- H. Supports: Provide supporting devices of types, sizes and materials indicated; and having the following construction features:
  - 1. One-Hole Conduit Straps or Minerallac: For supporting 3/4 inch and smaller conduit, galvanized steel.
  - 2. Two-Hole Conduit Straps or Minerallac or industry approved equal: For supporting 1 inch and larger conduit, galvanized steel; 3/4 inch strap width; and 2-1/8 inch between center of screw holes.
- I. Fabricated Supporting Devices:
  - 1. General: Shop- or field-fabricated supports or manufactured supports assembled from U-channel components.
  - 2. Steel Brackets: Fabricated of angles, channels, and other standard structural shapes. Connect with welds and machine bolts to form rigid supports.
  - 3. Pipe Sleeves: Provide pipe sleeves of one of the following:
    - a. Sheet Metal: Fabricate from galvanized sheet metal; round tube closed with snap lock joint, welded spiral seams, or welded longitudinal joint.
    - b. Fabricate sleeves from the following gauge metal for sleeve diameter noted:
      - 1) 3-inch and Smaller: 20 gauge

- 2) 4-inch to 6-inch: 16 gauge
    - 3) Over 6-inch: 15 gauge
  - c. Steel Pipe: Fabricate from Schedule 40 galvanized steel pipe.
  - d. EMT, IMC, or Rigid Conduit.
- J. The following are prohibited.
- 1. Plastic or fiber anchors.
  - 2. Drilling or structured steel members.

## PART 2 - EXECUTION

### 2.1 INSTALLATION, GENERAL

- A. Conduit Hangers: Support individual conduit 1-1/2 inch and larger and all multiple conduit runs with hangers. Clamp conduits individually to each support.
- B. Supports and Hangers:
- 1. Support and align all raceways, cabinets, boxes, fixtures, etc., in an accepted manner and as herein specified. Support raceways on accepted types of wall brackets, specialty steel clips or hangers, ceiling trapeze hangers or malleable iron straps. Provide lead expansion shields in concrete, machine screws, bolts or welding on metal surfaces, and wood screws on wood construction. Use of powder-driven studs is prohibited without express permission from the University Project Manager.
    - a. Mount all conduits to structure a minimum of 7 inches above any accessible type ceiling, or with spacing as required to permit relocation of recessed fixtures to any location.
  - 2. Structural and post tensioned concrete members shall not be drilled or pierced without prior approval from the University Project Manager.
  - 3. Where outlets are installed in steel stud type systems, provide additional cross bracing, bridging and/or straps as required to make outlet completely rigid prior to application of wall facing material.
  - 4. Design hangers and wall brackets so that maximum deflection will be no greater than 1/8 inch.
  - 5. Install supporting devices to fasten electrical components securely and permanently in accordance with NEC requirements.
  - 6. Coordinate with the building structural system and with other electrical installation.
- C. 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 pounds, provide additional strength until there is a minimum of 200 pounds 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 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. Threaded rod shall be covered by 1/2 inch conduit from bottom of (trapeze) support to 6-inches above cable tray.
  - 6. Support individual horizontal raceways by separate pipe hangers.
  - 7. Space supports for raceways in accordance with NEC.
  - 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 double nut. Remove sharp edges.

- D. 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, panel boards, disconnects, control enclosures, pull boxes, junction boxes, transformers, and other devices.
- E. In open overhead spaces, support metal boxes directly from the building structure 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 engineer approved type of fastener not more than 24 inches from the box.
- F. Sleeves: Install in walls and all other fire-rated floors and walls for raceways and 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 enclosed conduits and cables. See Engineering plans for location and extent of fire rated assemblies.
- G. 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, bus ways, cabinets, panel boards, 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. Powder-driven studs are not acceptable. 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% of the proof test load. Use vibration- and shock-resistant fasteners for attachments to concrete slabs.

**END OF SECTION 26 05 29**



## SECTION 26 05 33 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

### PART 1 - PRODUCTS

#### 1.1 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Conduit: Allied
    - a. Republic
    - b. Carlon
  2. Fittings and Bodies:
    - a. O/Z Gedney
    - b. Regal was purchased by Bridgeport
    - c. Bridgeport
    - d. Raco
    - e. Appleton
  3. Conduit Seals:
    - a. Chase-Foam CTC PR-855, or approved equal

#### 1.2 MATERIALS, GENERAL

- A. Metal Conduit and Tubing:
1. Electrical Metallic Tubing (EMT):
    - a. Conduit: Galvanized steel tubing, galvanized on the outside and coated on the inside with a hard smooth lacquer finish. Fittings: Steel compression fittings for rain-tight and concrete-tight applications. Steel set-screw for interior connections. Set-screw quick fit type for 2-1/2 inch and larger may be used. Bushings shall be threaded and have nylon insulated throat or nylon bushing.
  2. Rigid Aluminum Conduit:
    - a. Not allowed unless otherwise noted.
  3. Flexible Metal Conduit:
    - a. Conduit: Continuous spiral wound, interlocked, zinc-coated steel, NEMA/UL approved for grounding.
    - b. Fittings: Cadmium plated, 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 1 inch and larger shall be terminated with threaded bushings having nylon insulated throats.
    - c. Maximum length of 6 feet.
    - d. Minimum size of 3/4 inch.
  4. Liquid-Tight Flexible Metal Conduit:
    - a. Conduit: Continuous spiral wound, interlocked zinc-coated steel with polyvinyl chloride (PVC) jacket, NEMA/UL approved for grounding.
    - b. Fittings: Cadmium plated 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.
- B. Conduit Bodies:
1. General: Types, shapes and sizes, as required to suit individual applications and National Electric Code (NEC) requirements. Provide matching gasket covers secured with corrosion-resistant screws.
  2. Metallic Conduit and Tubing: Use metal conduit bodies. Use bodies with threaded hubs for threaded raceways and in hazardous locations.

3. Telephone EL's are not acceptable.

### 1.3 MATERIALS, GENERAL

- 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. Exterior Finish: Gray baked enamel for items exposed in finished locations except as otherwise indicated.
- E. Metal outlet, device, and small wiring boxes:
  1. General: Boxes shall be of type, shape, size, and depth to suit each location and application.
  2. Steel Boxes: 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.
- F. Outlet Boxes, Pull and Junction Boxes (J-Boxes):
  1. General: Boxes shall have screwed or bolted-on covers of material same as box and shall be of size and shape to suit application.
  2. Steel Boxes: Sheet steel with welded seams. Where necessary to provide a rigid assembly, construct with internal structural steel bracing.
  3. 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.
  4. Outlet Boxes: Hot-dipped galvanized of required size, 4 inch square, 2" depth minimum or octagonal and of depth required for flush mounted devices and lighting fixtures. Cast-type with gasketed covers for surface-mounted devices. All outlets for exterior application shall be cast, weatherproof type with gasket and cast cover plate.
  5. Junction and Pull Boxes: Use outlet boxes as J-boxes wherever possible. Larger J-boxes pull boxes shall be accessible and shall be fabricated from sheet steel, sized according to code.
- G. Non metallic boxes are not permitted.

## PART 2 - EXECUTION

### 2.1 INSTALLATION, GENERAL

- A. Conduit Sizes:
  1. The conduit shall be sized in accordance with NEC.
    - a. For power and lighting circuits, the minimum conduit size shall be 3/4"
    - b. Flexible and Liquid-tight Flexible Conduit: 1/2 inch for all runs. Maximum 6-foot length.
    - c. Conduits used for home runs shall contain only the conductors for the circuits indicated on the drawings. Combining unrelated multiple home runs into a single conduit would not be permitted.
- B. Type of Conduit Used
  1. Electrical Metallic Tubing (EMT):
    - a. Interior concealed spaces.
    - b. Interior exposed above 10 feet to floor.
    - c. Not permitted underground, in concrete, and in hazardous or corrosive areas.

2. Sealtite metal conduit shall be provided for: Makeup of motor, transformer or equipment, and/or raceway connections where isolation of sound and vibration transmission is required. For connections in locations exposed to weather, or in interior locations subject to moisture, watertight flexible conduit shall be used.
- C. General: Install electrical raceway in accordance with manufacturer's written installation instructions, 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.
  2. Elevation of Raceway: Where possible, install horizontal raceway runs above water and steam piping, keep close to structure.
  3. Complete installation of electrical raceways before starting installation of conductors within raceways.
  4. Provide supports for raceways as required per NEC. Prevent foreign matter from entering raceways by using temporary closure protection.
  5. 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. All bends shall be made in an approved bending machine or factory-made. Hickey bends will not be permitted in conduits larger than 3/4 inch. Refer to Section 27 05 28 for special bending requirements for Telecommunications Systems.
  6. Use raceway fittings that are of 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 and in every 200 feet of linear conduit run. A flexible bonding jumper at least three times the nominal width of the joint shall be installed.
  7. Run concealed raceways parallel and perpendicular to building elements at right angles.
  8. Install exposed raceways parallel and perpendicular to nearby surfaces or structural members and follow the surface contours as much as practical. Paint all exposed raceways to match surrounding area.
  9. Run exposed and parallel raceways together. Make bends in parallel runs from the same centerline 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.
  10. 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.
  11. 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 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 inch to 1 inch. 1-1/4 inch and above shall be metal with nylon insulated throats. Use grounding type bushings for feeder conduits at switchboards, panel boards, pull boxes, transformers, motor control centers, VFDs, etc.
  12. 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.
  13. Install pull wires in empty raceways. Use #14 AWG zinc-coated steel or monofilament plastic line having not less than 200-pound tensile strength. Leave not less than 12 inches of slack at each end.
  14. 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 required by the NEC.

15. Flexible Connections: Use short length (maximum of 6 feet) of flexible conduit for recessed and semi-recessed lighting fixtures, 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 in all flexible connections.
16. Conduit Seals: Conduit passing through concrete walls shall be sealed.
17. Where conduits are to be installed through structural framing members, the contractor shall provide sleeves. Cut all openings in concrete with rotary type drill, or other method as approved by the University Project Manager. Holes cut with pneumatic hammer will not be accepted. For areas where sleeves have not been provided, the Engineer's written approval must be obtained prior to cutting, notching or drilling of structural framing members.
18. Ream the ends of all cut and/or threaded conduit. Ends shall be cut square.
19. Use of running threads for rigid metallic conduit are not permitted. When threaded couplings cannot be used, provide 3-piece union or solid coupling.
20. Conduits shall not cross pipe shafts or ventilation duct openings "access panel".
21. Conduit shall not obstruct full and direct access to equipment requiring maintenance. This includes but is not limited to valves, actuators and terminal box controllers.
22. Install an insulated ground conductor in all conduits.
23. Where individual conduits penetrate fire-rated walls and floors, 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. Conduits on trapeze type support system shall require fire taping only.
24. 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.
25. Provide separate raceway systems for each of the following:
  - a. Lighting
  - b. Power Distribution
26. Provide for waterproofing of all raceways, fittings, etc., which penetrate the roof to preserve the weatherproof integrity of the building. Installation of materials shall conform to the following:
  - a. General:
    - 1) Install all raceways concealed except at surface cabinets, for motor and equipment connections and in mechanical equipment rooms. Install a minimum of 6 inch from flues, steam pipes or other heated pockets for water-flashing and counter-flashing or pitch pockets for waterproofing of all raceways, outlets, fittings, etc., which penetrate roof. Route exposed raceways parallel or perpendicular to building lines with right angle turns and symmetrical bends. Concealed raceways shall be run in a direct line, and where possible, with long sweep bends and offsets.
    - 2) Provide raceway expansion joints with necessary bonding conductor at building expansion joints and where required to compensate for raceway or building thermal expansion and contraction. Terminate raceways 1-1/4 inch and larger with insulated bushing or rain tight connections with insulated throats.
27. Special areas methods for raceway installation (with appropriate seal-offs, explosion-proof fittings, etc.), in all special occupancy areas, as defined and classified in Article 500 of the National Electric Code (NEC), shall be in accordance with that Article.
28. If type MC or AC cable is used for branch circuits, the home run conduit will be EMT and must run from the panel to within 10 feet horizontally of the first device served.

D. Raceway Installation:

1. Surface raceways, where indicated on drawings, shall be metal and of a size approved for number and size of wires to be installed, shall be installed in a neat, workmanlike manner, with runs parallel or perpendicular to walls and partitions. Raceways, elbows, fittings, outlets and devices shall be of same manufacturer, and designed for use together.
2. Wire ways, where indicated, complete with elbows, tees, connectors, adaptors, etc., with all parts factory-fabricated and of same manufacture.

## 2.2 INSTALLATION, GENERAL

### A. Boxes:

1. Every J-box shall be secured, independent of conduit entries into the box. Boxes shall be secured to the building structure. Ceiling wire shall not be used to support (secure) J-boxes.
2. Box fill shall be governed by code requirements. Only the allowable amount of conduit entries shall be allowed into the box.
3. Box covers shall be marked so as to indicate the voltage, panel number, and circuit number of the enclosed conductors.
4. Each J-box shall have only one voltage installed.
5. Cap unused knockout holes where blanks have been removed and plug unused conduit hubs.
6. Sizes shall be adequate to meet NEC volume requirements, but in no case smaller than sizes indicated.
7. Remove sharp edges where they may come in contact with wiring or personnel.
8. All conduits connected to a flush panel shall be concealed.

### B. Outlet Boxes:

1. Exact location of outlets and equipment shall be governed by structural conditions and obstructions or other equipment items. When necessary, relocate outlets so that when fixtures or equipment are installed, they will be symmetrically located according to room layout and will not interfere with other work or equipment. Verify final location of all outlets, panels, equipment, etc. with the University Project Manager.
2. Switch Outlet and Panel board height dimensions to meet ADA requirements.
3. Above counters, benches, special equipment, baseboards, fin tube radiators, etc., or at wainscoting, outlets shall be mounted minimum 6 inches above to prevent interferences to service equipment, or as noted on drawings.
4. Outlets at windows and doors: Locate close to window trim in an accessible location. For outlets indicated above doors center outlets above the door opening except as otherwise indicated.
5. 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. Locate in an accessible location.
6. 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.
7. Mounting: Mount outlet boxes for switches and receptacles with the long axis vertical or as indicated. 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 strike side, close to door trim. Provide far side box supports for electrical boxes installed on metal studs.
8. Ceiling outlets: For fixtures, where wiring is concealed, use outlet boxes 4-inches square by 1-1/2 inches deep, minimum.
9. Protect outlet boxes to prevent entrance of plaster, and/or debris. Thoroughly clean foreign material from boxes before conductors are installed.
10. Existing outlet boxes: Where extension rings are required to be installed, drill new mounting holes on the existing boxes where existing holes are not aligned.
11. Back to back outlet boxes are not permitted. Separate boxes a minimum of 6 inches in standard walls and 24 inches in acoustical walls.

### C. Installation of Pull and J-Boxes:

1. Box selection: For boxes in main feeder conduit runs, use minimum 8-inches square by 4-inches deep or as needed per NEC. Do not exceed 6 entering and 6 leaving raceways in a single box.
2. 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.

3. Mount pull boxes in inaccessible ceilings with the covers flush with the finished ceiling.
  4. Every J-box shall be secured, independent of conduit entries into the box. Boxes shall be secured to the building structure. Provide rigid supports for all J-boxes, ceiling wire supports are not acceptable.
  5. Box fill shall be governed by code requirements. Only the allowable amount of conduit entries shall be allowed into the box.
  6. Box covers shall be marked so as to indicate the voltage, panel numbers, and circuit number of the enclosed conductors. Use pre-printed labels, marking cover with permanent marker is not acceptable.
- D. Grounding:
1. 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.
- E. Outlets:
1. Provide zinc-coated or cadmium-plated sheet steel outlet boxes not less than 4 inch octagonal or square, unless otherwise noted. Equip fixture outlet boxes with 3/8-inch no-bolt fixture studs. Where fixtures are mounted on or in an accessible type ceiling, provide a J-box and extend flexible conduit, maximum 6' to each fixture. Outlet boxes in finished ceilings or walls shall be fitted with appropriate covers, set to come flush with the finished surface. Where more than one switch or device is located at one point, use gang boxes and covers unless otherwise indicated. Sectional switch boxes or utility boxes will not be permitted. Provide tile box or a 4-inch square box with tile ring where "drywall" type materials are applied.
- F. Pull and J-Boxes and Cabinets:
1. Construct J-boxes or pull boxes not over 150 cubic inches in size as standard outlet boxes, and those over 150 cubic inches the same as "Cabinets," with hinged covers of same gauge metal. Removable covers must be accessible at all times.
  2. Provide a standard access panel having a hinged metal door neatly fitted into a flush metal trim, where a J-box or equipment is located above non-accessible ceilings or behind finished walls. Coordinate location and type with the University Project Manager. Access panels shall be minimum 24"x24" or 6" larger than pull box.
  3. All cabinets shall be set rigidly in place with fronts straight and plumb, center panel board interiors in door openings.

**END OF SECTION 26 05 33**

## SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

### PART 1 - PRODUCTS

#### 1.1 MANUFACTURERS

- A. Acceptable 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.
  - 5. W.H. Brady, Co.

#### 1.2 MATERIALS, GENERAL

- A. Nameplates: Engraved plastic laminate, black letters on white background for normal systems and white letters on red background for emergency systems.
- B. Electronic Labels: 9mm self-adhesive tape, black letters on clear for normal systems and red letters on clear for emergency systems. Embossed DymoType labels are not accepted.
- C. Wires and Cable Markers: Cloth markers, split sleeve and tubing type.

### PART 2 - EXECUTION

#### 2.1 INSTALLATION, GENERAL

- 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 submittals and as required by code.
- B. Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work. Degrease and clean surfaces to receive nameplates and labels.
- C. Conduit Identification: Use adhesive marking labels at 40 foot intervals 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. Use the following colors:
  - 1. 600 Volt and Below: Black letters on orange background indicating feeder identification and
  - 2. Other Systems: Provide color banding as specified below.
- D. Identify Junction, Pull, and Connection Boxes: Identification of systems and circuits shall be pressure-sensitive, self-adhesive label indicating system voltage and identity of contained circuits on outside of box cover. Color code shall be same as conduits for pressure sensitive labels. Use pressure-sensitive plastic labels at exposed locations and indelible marker (black or red) at concealed boxes. All fire alarm boxes shall have covers painted red.
- E. Power Circuit Identification: Tag or label conductors as follows:
  - 1. Multiple Circuits: Where multiple branch circuits or control wiring or communications/signal conductors are present in the same box or enclosure label each conductor or cable including neutrals. Provide legend indicating source, voltage, circuit number, and phase for branch circuit wiring. Phase and voltage of branch circuit wiring may be indicated by means of coded color of

- conductor insulation. For control and communications/signal wiring, use color coding or wire/cable marking tape at terminations and at intermediate locations where conductors appear in wiring boxes, troughs, and control cabinets. Use consistent letter/number conductor designations throughout on wire/cable marking tapes.
2. Match identification markings with designations used in panel boards shop drawings, Contract Documents, and similar previously established identification schemes for the facility's electrical installations.
- F. 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 panel boards and alarm/signal components, where labeling is specified elsewhere.
- G. For panel boards, provide framed, typed circuit schedules (label all spares and spaces in pencil) with explicit description and identification of items controlled by each individual breaker.
- H. Install labels at locations indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment.
- I. Provide tape labels for identification of individual receptacle and switch wall plates. Locate tape on front of plate and identify branch circuit serving the receptacle or switch.

**END OF SECTION 26 05 53**



## SECTION 26 27 26 - WIRING DEVICES

### PART 1 - PRODUCTS

#### 1.1 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide wiring devices of one of the following:
1. Devices:
    - a. Leviton Mfg. Co.
    - b. Pass and Seymour Inc.
    - c. Bryant Electric Co.
    - d. General Electric Co.
  2. Wall (Local) Switches: Numbers used below are those of Hubbell. Equivalent Cooper, P & S, or Leviton.

#### 1.2 MATERIALS, GENERAL

- A. Receptacles:
1. Duplex receptacles shall be of the heavy-duty type, NEMA 5-20 Rconfigurations. They shall be capable of being side or back wired, with clamp type terminals for back wiring. The grounding blades shall be aligned in such a manner that they are parallel to the longitudinal plane of the receptacle. Plus type receptacles are not permitted.
  2. All duplex, single, and special receptacles shall be heavy duty, standard grade listed by Underwriter's Laboratories, and have a single brass 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.
  3. Convenience Receptacle Configuration: NEMA WD 1; Type 5-20R.. All receptacles connected to emergency circuits shall have a red face. Color selection for normal devices shall be verified with Engineer prior to ordering.
  4. Special Purpose Receptacles: Provide where shown on drawings. Standard grade, standard color, and of the appropriate code and NEMA configuration to match the supply circuit and load involved. Provide proper grounding through receptacle for equipment.
- B. Switches:
1. Wall Switches for Lighting Circuits: NEMA WD1; FS W-S-896E; AC, quiet type, specification grade, listed by Underwriter's Laboratories with toggle handle, rated 20 amperes or greater at 277 volts AC, unless noted otherwise. Mounting straps shall be metal and be equipped with a green hex-head ground screw. Each switch shall bear the UL/FS Label.
  2. Locator Type: Continuously lighted handle.

Single-Pole Switches	#1221	20 amps	277 volts
Three-Way Switches	#1223	20 amps	277 volts
Four-Way Switches	#1224	20 amps	277 volts
Switch with Pilot		Series 1200	

- C. Wiring Device Accessories:
1. 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. 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:

- a. Material and Finish: Stainless steel smooth or match existing.

## PART 2 - EXECUTION

### 2.1 EXAMINATION

- A. Verify boxes are installed at proper height and openings are neatly cut and will be completely covered by wall plates.
- B. Verify branch circuiting wiring installation is completed, tested, and ready for connection to wiring devices.

### 2.2 INSTALLATION, GENERAL

- A. Install wiring devices of type as indicated on drawings. All connections shall be made up tight and device set plumb. Use care in installing device in order to prevent damage to device and wire in outlet box. Install wiring devices as indicated, in accordance with manufacturer's written instruction, 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 that are clean; free from excess building materials, dirt, and debris.
- D. Install wiring devices after wiring work has been installed and wall finishes have been completed. Install wall plates plumb and level, after painting work is completed. Provide a device plate for each outlet to suit device installed and install blank plates or covers for J-boxes and empty outlets.
- E. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for wiring devices or as required per UL Standards 486A.
- F. Upon installation of wall plates and receptacles, advise Contractor regarding proper and cautious use of convenience outlets. At time of Final Completion, replace those items that have been damaged, including those burned and scored by faulty plugs.
- G. Provide equipment grounding connections for wiring devices, unless otherwise indicated.

### 2.3 TESTING, CLEANING, AND CERTIFICATION

- A. Refer to Standard Section 26 05 00 for testing, cleaning, and certification requirements.
- B. Prior to energizing circuitry, test wiring for electrical continuity, and for short-circuits. Ensure proper polarity of connections is maintained. Subsequent to energization, test wiring devices to demonstrate compliance with requirements.
- C. Test ground fault interrupter operation with both local and remote fault simulations in accordance with manufacturer recommendations.

**END OF SECTION 26 27 26**

## SECTION 26 51 00 - INTERIOR LIGHTING

### PART 1 - GENERAL

#### 1.1 SUBMITTALS

- 1.2 Product Data: Submit product data with mounting type and installation instructions for each proposed types of luminary and accessories.

#### 1.3 DELIVERY, STORAGE AND HANDLING

- A. Deliver luminaries in factory-fabricated containers or wrappings, which properly protect them from damage.
- B. Store luminaries in original packaging. Store inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, humidity, laid flat, and blocked off ground.
- C. Handle luminaries carefully to prevent damage, breaking, and scoring of finishes. Do not install damaged units or components; replace with new.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS, GENERAL

- A. Wiring: Provide electrical wiring within luminary suitable for connecting to branch circuit wiring as follows:
  - 1. NEC Type THHN/THWN for 120 volt, minimum #18 AWG
  - 2. Provide a green grounding wire in flexible conduit connection to all recessed fixtures. Provide green grounding wire to all power outlets. Provide green grounding wire in all runs from panels to fixtures and devices.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas and conditions under which lighting is to be installed, and substrate for supporting lighting. 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 INSTALLATION, GENERAL

- A. Install lighting at locations and heights as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC, NECA's "Standard of Installation," NEMA standards, and with recognized industry practices to ensure that lighting fulfills requirements.
- B. Provide luminaries and/or outlet boxes with hangers to properly support luminary weight. Comply with IBC luminary support requirements.
- C. Fasten luminaries securely to indicate structural supports; and ensure that pendant luminaries are plumb and level. Provide individually mounted pendant luminaries longer than 2 feet with twin hangers. Mount continuous rows of luminaries with one more aircraft cable support greater than number of luminaries in the row.

- D. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torque requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standards 486A and 486B, and the National Electrical Code (NEC).
- E. Provide additional supports for all surface-mounted luminaries greater than 2 feet in length in addition to the outlet box.
- F. Overall dimensions of incandescent or fluorescent fixtures recessed in suspended grid ceilings shall be such that they will fit into grid ceiling with no distortion or field repair to fixtures and with no distortion of ceiling grids. If field repair is required, the engineer shall be notified immediately. All fixtures must be supported independent of the ceiling grid per NEC. Coordinate installation of the fixtures with installer of ceiling so that ceiling will be absolutely level after completion.
- G. Grounding: Provide equipment-grounding connections for lighting as indicated. Tighten connections to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounds.

### 3.3 TESTING, CLEANING, AND CERTIFICATION

- A. Clean luminaries of dirt and construction debris upon completion of installation, and again prior to project turnover. Clean fingerprints and smudges from lenses.
- B. Protect installed luminaries from damage during remainder of construction period.

**END OF SECTION 26 51 00**

## SECTION 26 56 00 - EXTERIOR LIGHTING

### PART 1 - GENERAL

#### 1.1 SUBMITTALS

- A. Product Data: Submit manufacturer's product data with mounting type and installation instructions on each proposed type of luminary and accessories.

#### 1.2 DELIVERY, STORAGE, AND HANDLING

- A. Deliver lighting in factory-fabricated containers or wrappings, which properly protect luminaries from damage.
- B. Store lighting in original packaging. Store inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, humidity, laid flat, and blocked off ground.
- C. Handle lighting carefully to prevent damage, breaking, and scoring of finishes. Do not install damaged units or components; replace with new.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers: As indicate on Construction Documents.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION, GENERAL

- A. Install lighting at locations and heights as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC, NECA's "Standard of Installation," NEMA standards, and with recognized industry practices to ensure that lighting fulfills requirements.
- B. Fasten luminaries securely to structural supports and ensure that luminaries are plumb and level.
- C. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torque requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standards 486A and 486B, and the National Electrical Code (NEC).
- D. Grounding: Provide equipment-grounding connections for lighting as indicated. Tighten connections to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounds.

#### 3.2 TESTING, CLEANING, AND CERTIFICATION

- A. Clean lighting of dirt and construction debris upon completion of installation. Clean fingerprints and smudges from lenses.
- B. Protect installed luminaries from damage during remainder of construction period.

- C. Upon completion of installation of lighting and after circuitry has been energized, apply electrical energy to demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at site, then re-test to demonstrate compliance; otherwise, remove and replace with new units and proceed with re-testing.

**END OF SECTION 26 56 00**

## SECTION 28 31 00 - FIRE DETECTION AND ALARM

### PART 1 - GENERAL

#### 1.1 SYSTEM DESCRIPTION

- A. Expand and modify existing fire alarm system to provide the indicated notification and monitoring indicate on the drawings.

#### 1.2 PERFORMANCE REQUIREMENTS

- A. Failsafe Operation: To increase the system's ability to survive damage from fire, malicious or accidental damage, premature component failure, etc., the fire alarm system shall provide the following functionality:
1. Each building FACP shall operate in a stand-alone manner, independent of any other FACP or FACT. The building FACP shall contain the complete data file for all connected devices, regardless of the building, and shall operate the same way whether connected to any other FACP or FACT. This includes:
    - a. Annunciation of device address and condition. One hundred percent of all connected devices shall be capable of operating for alarm simultaneously.
    - b. Logical Point Grouping annunciation and control. Each Logi-cal Point Group shall contain up to 15 physical points and shall be capable of initiating a sequence of control actions.
    - c. Event-initiated control, signaling and/or annunciation sequences. One hundred percent of all connected devices shall be capable of being operated simultaneously.
    - d. Priority display of multiple alarms.
    - e. Complete supervision of all connected devices with no degraded operation.
    - f. Complete reset capabilities at FACP and FACT.
  2. Standby batteries capable of operating the FACP, FACT (except those supported by non-interruptible power supply systems), FAAP, FVEP, smoke detectors and alarm horns, strobes, secondary PC terminals, video display units and printers, shall be provided to automatically back up the emergency power source. The system shall have the capacity to operate FACP, as required per NFPA PCs for two hours, and then operate the fire alarm indicating devices for at least 15 minutes, per NFPA requirements. When commercial power is restored, the system shall transfer automatically to primary power. System power supply shall be equipped with battery charging circuits sufficient to recharge fully depleted batteries to within 70 percent of their maximum capacity within 12 hours.
- B. Color code and minimum wire sizes for the fire alarm system as follows:
1. All wire is solid copper:
  2. All insulation colors shall be continuous for the full length of the wire.
  3. Wire Jackets shall be stamped with the "Circuit Type" designation or shall have an affixed label designating the "Circuit Type" every twenty lineal feet at a minimum.

Circuit Type	Colors		Size
	Wire	# Of Conductors	
Initiating Circuits	(+) Red (-) Black	2	18 (THHN)
Signaling Circuits	(+) Red (-) White	2	16 Twisted
Strobe Circuits	(+) Yellow (-) Blue	2	14 Twisted

- C. Interface With Other Systems:
  - 1. Hood fire suppression system.

### 1.3 SUBMITTAL

- A. Provide shop drawings as follows:
  - 1. Floor plans with device layout, address and wiring.
  - 2. FACP layout.
  - 3. Riser diagrams.
  - 4. Battery calculation.
  - 5. Sequence of operation
  - 6. Equipment cut sheets
  - 7. FAAP layout.
- B. CADD generated layouts for FACT screen graphics.
- C. Operating and Maintenance Manuals.
- D. Project Record Documents:
  - 1. Prior to submittal of the as-built documents, submit a complete package of shop drawings to the university Facilities Operations Fire and Safety office for review. Drawings shall include floor plans and graphic maps for each building and/or floors.
  - 2. Submit record documents in accordance with the requirements of Section 01 78 39 and the following:
    - a. As-built point-to-point wiring diagrams depicting every device, including correct university room numbers.
    - b. Revised schematic, wiring, and interconnection diagrams of all circuits, internal and external, for all equipment installed and exact locations for all devices. These schematics shall include the conductor color-coding and terminal number identification system, location of all terminal boxes complete with numbering and each device address.
    - c. Complete, as-installed, riser diagrams indicating the wiring sequence of all alarm initiating devices, supervisory devices, and all signaling appliances on all signaling circuits.
    - d. A complete description of the system operation, including a schedule of relay abbreviations used on the drawings, list of relay functions, and the sequence of relay operation during supervisory trouble and alarm conditions.
    - e. Complete wiring and control diagrams for control and shutdown circuits for fan systems.

### 1.4 QUALITY ASSURANCE

- A. Installer: Company with certified personnel specializing in smoke detection and fire alarm systems with five years' documented experience as a fire alarm installing contractor.
- B. Fire Management system installer shall keep all smoke heads in the building covered until final building turn over. Failure to comply will mandate a complete cleaning of the individual heads on the system.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Monaco Enterprise Inc.

### 2.2 APPROVED INSTALLERS



- A. Metroplex Control System (MCS) – 6950 South Tucson Way, Unit D, Centennial, CO 80112, (720) 875-0303.
- B. Advanced Electronic System – 801 Main Street, Windsor, CO 80550, (970) 686-6200
- C. FAS (Fire Alarm Services) – 4800 W 60th Ave, Arvada CO, 80003 (303) 466-8800
- D. Meridian Fire and Security – 7173 S. Havana St Ste 400 Centennial CO, 80112 (303) 790-2520
- E. Other installers will be considered if they have successfully completed 3 similar projects (in size and complexity) in the past 5 years in the Denver Metro area. The installer must have a demonstrated ability to provide ongoing service to any system it installs. Alternate installers must be approved in writing by the University Project Manager through Facilities Operations 5 working day prior to Bidding on the project. Installers should be NICET certified.

## 2.3 MATERIALS, GENERAL

- A. All equipment and materials used shall be standard components, regularly manufactured, and regularly utilized in the manufacturer's system.
- B. All systems and components shall have been thoroughly tested and proven in actual use.
- C. All equipment shall be listed and labeled by Underwriters Laboratories.
- D. All sensors shall be of the intelligent type and shall mount on a common base. This base shall be incompatible with conventional detectors.
- E. Where equipment of different manufacturers is used, such equipment shall be included under the required over-all UL system listing as a component of the integrated fire alarm system.
- F. The system shall be designed to operate with unshielded wire, to the maximum practicable extent. Shielded wire may be used. FO cable shall be utilized, as required or as indicated by the design documents.
- G. Fire Alarm System Devices:
  - 1. General:
    - a. Each device shall be assigned a unique address. Address selection by jumpers is not acceptable. Devices which take their address from their position in the circuit are unacceptable. It is preferred that the address of the intelligent device be part of the device base rather than the device itself.
    - b. Devices shall receive power and communication from the same pair of wires. For fault-tolerant circuits, any separate power wiring shall also be made fault-tolerant.
  - 2. Analog Sensors (Photoelectric and Thermal):
    - a. Each sensor shall contain an LED, which blinks each time it is scanned by the FACP. The sensor LED is to remain illuminated to indicate alarm. All sensors not visible from the corridor shall have a remote light mounted in the corridor as shown on the drawings.
    - b. Each sensor shall be capable of being tested for alarm via command from the FACP or FACT. The values of the sensor shall be displayed at building FACP and FACT, and the University Police FACT.
  - 3. Monitor Modules:
    - a. The Monitor Module shall provide an addressable input for N.O. or N.C. contact devices such as manual stations, water-flow switches, sprinkler supervisory devices, door contacts, intrusion detectors, etc.

- b. The Module shall mount in a standard electrical box.
  - 4. Intelligent manual pull stations shall be single action, mounted on standard electrical box.
    - a. For public places, use single action pull stations with "Stopper II" cover.
- H. Other Devices:
  - 1. Horn/Strobes:
    - a. Strobes shall be synchronized.
    - b. The horn shall provide for minimum sound level of 95 dBA at 10 feet.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION – FIRE ALARM

- A. Fire Alarm layouts:
  - 1. General:
  - 2. Regardless of building occupancy rating, the following areas shall be provided with detection:
    - a. Kitchens
  - 3. In general, the following type of detection shall be provided in each type of room:
    - a. Thermal Detection:
      - 1) Kitchens/Break rooms
- B. Installation shall be supervised and tested by the manufacturer of the system equipment.
- C. Low Voltage/Wire and Cable: All LV/W&C shall be run in conduit in floors, walls and non accessible spaces. In hallways, LVW/C can be run in bridge rings attached to the common telecom and other low voltage system cable tray. LV/W&C must be run in a conduit sleeve, minimum 2" dia. with plastic bushings, from the point it leaves the bridge ring on the cable tray to the interior side of a room. Once the LV/W&C enters the room it can be supported from bridge rings or j-hooks. Wiring shall comply with Division 27 and approved NEC.
- D. Low Voltage/Wire and Cable and Hallway Devices: LV/W&C running from the cable tray to devices in the hallway shall be protected by plenum rated flexible sleeving or flexible metal conduit. LV/W&C in sleeving or flexible metal conduit shall be supported per NEC and installed with UL approved connectors and plastic bushings on both ends.
- E. Outlet pull and junction boxes shall be painted red on the exterior.
- F. Devices: Locate devices per ADA standards
- G. In construction areas where there is existing equipment, the equipment must be protected during construction and the devices taken off line to eliminate false alarms. All devices associated with modifications to an existing system must match existing devices.
- H. Contractor is liable for damage. The university must be notified at the completion of each project to ensure that the system is returned to normal.
- I. Labeling:
  - 1. Observe the university fire alarm color code guide.
  - 2. Label each splice with correct information.
  - 3. Label each initiating device with correct device address. Use Kroy labeler or equal.
  - 4. Final, correct university room numbers (not design/construction room numbers) must be provided for correct programming.

5. All detectors to have factory dust covers installed until after the final inspection and clean up is complete.
6. All shielded wiring to be bonded together at each device and insulated from contact with the conduit or box.
7. All equipment and associated wiring removed from service will be returned to the University Project Manager for proper disposal.
8. Avoid locating detectors above countertops and/or shelving.
9. Locate detectors at least eight feet from supply or return air diffusers.

J. Construction Requirements:

1. Integrity of Structure: Do not drill or pierce structural members without prior approval from the University Project Manager and Structural Engineer.
2. Penetration of Walls, Etc.: Fire caulks or seal all penetrations made through walls, floors, and ceilings around the conduit. Maintain the integrity of fire ratings within the structure. Where visible, paint to match surface.
3. Wherever possible, install conduits and raceways in a concealed manner, except at surface-mounted cabinets.
4. Access to Existing Facilities: Install all conduit and pull boxes to maintain or provide access to existing valves; covers to existing pull boxes; wire ways or access doors; electrical outlets; switches; motors, etc.
5. Support bridle rings/"J" Hooks independently from structure, may have separate point of attachment to cable tray.
6. No other wiring or systems to be installed with fire alarm.

- K. Prior to start of construction, disable existing fire alarm devices, as necessary. A minimum of two working days notice, prior to construction, shall be coordinated through the University Project Manager.

### 3.2 TESTING, CLEANING AND CERTIFICATION

- A. When installation is complete, system shall be tested in accordance with NFPA72 requirements. A representative of the system manufacturer shall submit a written report of the findings to the A/E with copy of to the FD. System testing shall include, at the least, verifying the following:
1. The functional operation of each re-settable initiating device (manual stations, detectors, etc.) and circuit.
  2. All notification appliances shall be tested for a minimum of ten minutes under normal alarm conditions.
  3. The functional operation of each and every alarm device and circuit.
  4. The functional operation of each monitored device circuit.
  5. The functional operation of each control circuit, including fan controls.
  6. The supervision functions of each initiating, indicating, monitoring, control and supply circuit.
  7. Control station automatic signaling.
  8. That all software protocol, access codes and operation instructions have been supplied.
  9. All installed or modified fire alarm systems for remodels or new projects shall be tested and certified by a Factory Representative. Upon a system test completion a "Letter of Certification" shall be issued to the university.
- B. All testing and verifications shall be conducted in the presence of the university Facilities Operations Fire and Safety personnel.
- C. There shall be an operational test by the FD.

### 3.3 COMMISSIONING (DEMONSTRATION)

- A. The equipment supplier shall provide a minimum of 8 hours of system training for the university Facilities Operations personnel training for each new system.

**END OF SECTION 28 31 00**