UNIVERSITY OF COLORADO ANSCHUTZ MEDICAL CAMPUS
BUILDING 500 / 6TH FLOOR CANCER CENTER RENOVATION
SEPTEMBER 29, 2017

SPECIFICATIONS
CONSTRUCTION DOCUMENTS

BENNETT WAGNER GRODY
ARCHITECTS
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# PROJECT DIRECTORY

| **PROJECT** | University of Colorado Denver  
|             | Building 500: 6th Floor Cancer Center Renovation |
| **PROJECT NUMBER** | UCD NO. 17-289575  
|                 | BWG NO. 17045.00 |
| **OWNER** | Robert Holzwarth  
|             | robert.holzwarth@ucdenver.edu |
| **ARCHITECT** | Bennett Wagner Grody Architects  
|                | 1301 Wazee Street, Suite 100  
|                | Denver, Colorado 80204  
|                | 303-623-7323 303-623-2836 fax |
|             | Matt Bartels  
|             | mbartels@bwgarchitects.com |
|             | Linda Wagner  
|             | lwagner@bwgarchitects.com |
| **MECHANICAL, PLUMBING & ELECTRICAL** | The RMH Group, Inc.  
|                                | 12600 West Colfax Avenue, Suite A-400  
|                                | Lakewood, CO 80215  
|                                | 303-239-0909 |
|                     | Michelle Swanson  
|                     | mswanson@rmhgroup.com  
|                     | 303-239-2724 |
Request for Documented Quote
(Construction Purchase Order under $100K)

Project #: 17-289575
Project Name: B500 – 6th Floor Cancer Center Renovation

Documented Quote Due by (Date/Time): 10/20/2017, 2:00 PM

Project Manager: Robert Holzwarth
Email Address: robert.holzwarth@ucdenver.edu
Documented Quote Table of Contents
(Construction Purchase Order under $100K)

1. Advertisement for Documented Quote

2. Information to Bidders (SBP-6.12)
   NOTE: Electronic versions of all State Buildings (SBP and SC) forms can be found at https://www.colorado.gov/pacific/osas/formsproc

3. Bid Form (SBP-6.13)

4. Bid Alternates Form (SBP-6.131) – if used

5. Bid Bond (SBP-6.14) Not Included – Please Note: if the submitted Documented Quote is $50,000 or higher a Bid Bond is required

6. University of Colorado Denver Facilities Management Construction Purchase Order Terms and Conditions

7. Insurance Requirements (A), Construction Purchase Order Insurance Requirements University of Colorado Denver

8. As Applicable:
   University of Colorado Denver Supplemental Checklist for Projects Under 100K

9. Scope of Work
   Description/Specifications
   Plans/Other Supporting Documentation

Appendix A: University of Colorado Denver Tax Information
Agency: University of Colorado Denver | Anschutz Medical Campus

Notice Type: Documented Quote

Construction Cost Categories: Under $100K

Should this notice include print media information: No

Project No: 17-289575

Project Title: Building 500 6th Floor Cancer Center Renovation – SCPP Pre-Qualified Contractors Only

Project Description: The project includes the partial renovation of the west wing and north wing on the 6th Floor of Building 500 located on the University of Colorado Denver | Anschutz Medical Campus in Aurora, CO. The project scope includes reconfiguration of 5 private offices into 2 person shared offices and the interior renovation of 2 large workrooms into new open office space. Work includes, but is not limited to: miscellaneous demolition, new wall construction, acoustical ceilings, electrical, voice/data rough-in, lighting, HVAC modifications, floor finishes, patching and painting. Furniture procurement and installation will be contracted separately.

Project should be substantially completed within: 37 Calendar Days of issuance of P.O. (est. 11/29/17)

Project shall be finally complete within: 15 Calendar Days (after Substantial Completion, or approx. 12/14/2017)

Anticipated Construction Start Date: 10/23/17

Bidder may procure Bidding Documents from: http://www.ucdenver.edu/about/departments/FacilitiesManagement/FacilitiesProjects/RFP/Pages/RFP.aspx

Bid Documents will be available on 10/9/17

Deposit required for a complete set of Contract Documents: $0

ARRA Funding: No

Settlement Notices:

For all projects with a total dollar value above $150,000 Notice of Final Settlement is required by C.R.S. 38-26-107. Final Settlement, if required, will be advertised via Electronic Media

Scope of Services:

N/A

Submission Details:

Submission Deadline: 10/20/2017, 2:00 PM

Submissions Accepted Via: ☒ Email ☐ Fax ☒ In Person ☒ Mail

Details: All documented quotes shall be submitted to Robert Holzwarth – Robert.holzwarth@ucdenver.edu.

In addition to email and mail delivery options, documented quote submissions can also be hand delivered to: Facilities Projects, Room 310, 1945 Wheeling Street, Mail Stop F418, Aurora, CO 80045
**Point of Contact:**

Name: Robert Holzwarth  
Agency: University of Colorado Denver | Anschutz Medical Campus  
Phone: (303) 724-0749  
Fax: (303) 724-0931  
Email: robert.holzwarth@ucdenver.edu

**Meetings:**

Choose one:  
**Mandatory Pre-Bid**  
Date and Time: **10/10/2017, 2:00 PM**  
Details: Campus Services Building 1945 Wheeling Street, Aurora, CO 80045 – Conference Room 300  
Comments: Bids received from bidders who have not attended the mandatory pre-bid meeting will not be considered for the project. Questions will be collected until **10/14/2017 at 2:00 PM** from those who attended mandatory pre-bid meeting. Questions will be answered by **10/16/2017 at 2:00 PM**.

**Specification Details/Attachments:**

Attachments: Construction Documents and Bid Manual will be available on the University web site on 10/3/2017.

**Media of Publications:**

Media of Publication:  
http://www.ucdenver.edu/about/departments/FacilitiesManagement/FacilitiesProjects/RFP/Pages/RFP.aspx  
CORE

Publication Dates: **10/3/2017**
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:

   **Facilities Projects, Room 310, 1945 Wheeling Street, Mail Stop F418, Aurora, CO 80045**

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

   - Project #17-289575
   - Project Name **Building 500 6th Floor Cancer Center Renovation**
   - Name and Address of Bidder
   - Date of Opening **10/20/17**
   - Time of Opening **2:00 PM**

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.

4. **UNAUTHORIZED IMMIGRANTS:** Note that the Special Provisions of the General Conditions of the Contract includes the following language: **PUBLIC CONTRACTS FOR SERVICES - CRS 8-17.5-101 and PUBLIC CONTRACTS WITH NATURAL PERSONS - 24-76.5-101.** The Contractor certifies that the Contractor shall comply with the provisions of CRS 8-17.5-101 et seq. The Contractor shall not knowingly employ or contract with an illegal alien to perform work under this contract or enter into a contract with a subcontractor that fails to certify to the Contractor that the subcontractor shall not knowingly employ or contract with an illegal alien to perform work under this contract. The Contractor represents, warrants, and agrees that it (i) has verified that it does not employ any illegal aliens, through participation in the Basic Pilot Employment Verification Program administered by the Social Security Administration and Department of Homeland Security, and (ii) otherwise will comply with the requirements of CRS 8-17.5-102(2)(b). The Contractor shall comply with all reasonable requests made in the course of an investigation under CRS 8-17.5-102 by the Colorado Department of Labor and Employment. If the Contractor fails to comply with any requirement of this provision or CRS 8-17.5-101 et seq., the State may terminate this contract for breach and the Contractor shall be liable for actual and consequential damages to the State.

A Contractor that operates as a sole proprietor hereby swears or affirms under penalty of perjury that the Contractor (i) is a citizen of the United States or otherwise lawfully present in the United States pursuant to federal law, (ii) shall comply with the provisions of CRS 24-76.5-101 et seq, and (iii) shall produce one of the forms of identification required by CRS 24-76.5-103 prior to the effective date of this Contract. Except where
exempted by federal law and except as provided in CRS 24-76.5-103(3), a Contractor that receives federal or state funds under this contract must confirm that any individual natural person eighteen years of age or older is lawfully present in the United States pursuant to CRS 24-76.5-103(4) if such individual applies for public benefits provided under this contract.

5. **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.

6. **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.

7. **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.

8. **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 deductive 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.

9. **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.

The Advertisement for Bids can be located at the web site: [www.colorado.gov/pacific/osa/cdnotices](http://www.colorado.gov/pacific/osa/cdnotices)

(Click on the appropriate link [ColoradoVSS or ColoradoBIDS] or on the State Purchasing Office website)
STATE OF COLORADO  
OFFICE OF THE STATE ARCHITECT  
STATE BUILDINGS PROGRAMS  

BID

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

Project No./Name: 17-289575 / B500 - 6th Floor Cancer Center Renovation

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:

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:

b. Time Period from Substantial Completion to Final Acceptance:

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

1. BID: Pursuant to the advertisement by the State of Colorado dated [date], 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.

2. 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.

3. 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.

A. 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)

B. 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)

C. 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.

4. BID GUARANTEE: This Bid is accompanied by the required Bid Guarantee. 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 Director, State Buildings Programs, 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, Insurance Policy and Certificates of Insurance and Affidavit Regarding Unauthorized Immigrants.

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 and Affidavit Regarding Unauthorized Immigrants 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.

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

BID BOND

Institution/Agency: University of Colorado Denver | Anschutz Medical Campus / GFE
Project No./Name: 17-289575 / B500 - 6th Floor Cancer Center Renovation

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, Certificates of Insurance and Certification and Affidavit Regarding Illegal Aliens, 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

Company Name

ATTEST

Address (including city, state and zip)

Secretary

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.

State Form SBP-6.14
Rev. 10/2006
Facilities Management
Construction Purchase Order Terms and Conditions

1. Offer/Acceptance

If this purchase order ("PO") refers to vendor’s bid or proposal, this PO is an ACCEPTANCE of vendor’s OFFER TO SELL in accordance with the terms and conditions of the "solicitation" identified in vendor’s bid or proposal. The solicitation includes an RFP, IFB, or any other form of order by the University. If a bid or proposal is not referenced, this PO is an OFFER TO BUY, subject to vendor's acceptance, demonstrated by vendor’s performance or written acceptance of this PO. Any COUNTER-OFFER TO SELL automatically CANCELS this PO, unless a change order is issued by the University accepting a counter-offer. This PO shall supersede and control over any vendor form(s) or part(s) thereof included in or attached to any bid, proposal, offer, acknowledgment, or otherwise, in the event of inconsistencies or contradictions, regardless of any statement to the contrary in such form(s) or parts thereof.

2. Safety Information

All chemicals, equipment and materials proposed and/or used in the performance of this PO shall conform to the requirements of the Occupational Safety and Health Act of 1970. Vendor shall furnish all Material Safety Data Sheets (MSDS) for any regulated chemicals, equipment or hazardous materials at the time of delivery.

3. Changes

Vendor shall furnish products and/or services strictly in accordance with the specifications and price set forth for each item. This PO shall not be modified, superseded or otherwise altered, except in writing signed by purchasing agent and accepted by vendor. Each shipment received or service performed shall comply with the terms of this PO, notwithstanding invoice terms or acts of vendor to the contrary, unless this PO has been modified, superseded or otherwise altered in accordance with this section.

4. Delivery

Unless otherwise specified in the solicitation or this PO, delivery shall be FOB destination. The University is relying on the promised delivery date, installation, and/or service performance set forth in vendor’s bid or proposal as material and basic to the University’s acceptance. If vendor fails to deliver or perform as and when promised, the University in its sole discretion, may cancel its order, or any part thereof, without prejudice to its other rights, return all or part of any shipment so made, and charge vendor with any loss or expense sustained as a result of such failure to deliver or perform as promised. Time is of the essence.

5. Intellectual Property

Any software, research, reports, studies, data, photographs, negatives or other documents, drawings or materials (collectively "materials") delivered by vendor in performance of its obligations under this PO shall be the exclusive property of the University. Ownership rights shall include, but not be limited to, the right to copy, publish, display, transfer, prepare derivative works, or otherwise use the materials. Vendor shall comply with all applicable laws, regulations and University policies related to confidential information and all confidentiality and non-disclosure agreements, security controls, and reporting requirements.

6. Quality
The University shall be the sole judge in determining "equals" with regard to quality, price and performance. All products delivered shall be newly manufactured and the current model, unless otherwise specified.

7. Warranties

All provisions and remedies of the Colorado Uniform Commercial Code, CRS, Title 4 ("CUCC"), relating to implied and/or express warranties are incorporated herein, in addition to any warranties contained in this PO or the specifications.

8. Inspections and Acceptance

Final acceptance is contingent upon completion of all applicable inspection procedures. If products or services fail to meet any inspection requirements, the University may exercise all of its rights, including those provided in the CUCC. The University shall have the right to inspect services provided under this PO at all reasonable times and places. "Services" as used in this section includes services performed or tangible material produced or delivered in the performance of services. If any of the services do not conform to PO requirements, the University may require vendor to perform the services again in conformity with PO requirements, without additional payment. When defects in the quality or quantity of service cannot be corrected by re-performance, the University may (a) require vendor to take necessary action to ensure that future performance conforms to PO requirements and (b) equitably reduce the payment due vendor to reflect the reduced value of the services performed. These remedies do not limit the remedies otherwise available in this PO, at law, or in equity.

9. Cash Discount

The cash discount period will start from the later of the date of receipt of acceptable invoice, or from date of receipt of acceptable products/services at the specified destination by an authorized University representative.

10. Taxes

The University is exempt from all federal excise taxes under Chapter 32 of the Internal Revenue Code and from all State and local government sales and use taxes [CRS, Title 39, Article 26, Parts I and II].

11. Payment

The University shall pay vendor for all amounts due within 30 days after receipt of products or services and a correct notice of amount due. Interest on the unpaid balance shall begin to accrue on the 46th day at the applicable statutory rate. Interest shall not accrue if a good faith dispute exists as to the University's obligation to pay all or a portion of the amount due. Vendor shall invoice the University separately for interest on delinquent amounts due, referencing the delinquent payment, number of day's interest to be paid, and applicable interest rate.

12. Vendor Offset

[Not Applicable to Inter-governmental POs] The University may withhold payment as required under the State vendor offset intercept system for debts owed for: (a) unpaid child support debts or arrearages; (b) unpaid balances of tax, accrued interest, or other charges specified in CRS § 39-21-101, et seq.; (c) unpaid loans due to the Student Loan Division of the Department of Higher Education; (d) amounts required to be paid to the Unemployment Compensation Fund; and (e) other unpaid debts owing to the University.

13. Assignment and Successors
Vendor shall not assign rights or delegate duties under this PO, or subcontract any part of the performance required under this PO, without the express, written consent of the University. This PO shall inure to the benefit of and be binding upon vendor and the University and their respective successors and assigns. Assignment of accounts receivable may be made only upon written notice furnished to the University.

14. Indemnification

If any article sold or delivered under this PO is covered by a patent, copyright, trademark, or application therefore, vendor shall indemnify and hold harmless the University from any and all loss, liability, cost, expenses and legal fees incurred on account of any claims, legal actions or judgments arising out of manufacture, sale or use of such article in violation or infringement of rights under such patent, copyright, trademark or application. If this PO is for services, vendor shall indemnify, save, and hold harmless the University, its employees and agents, against any and all claims, damages, liability and court awards including costs, expenses, and attorney fees and related expenses, incurred as a result of any act or omission by vendor, or its employees, agents, subcontractors or assignees, arising out of or in connection with performance of services under this PO.

15. Independent Contractor

Vendor shall perform its duties hereunder as an independent contractor and not as an employee. Neither vendor nor any agent or employee of vendor shall be deemed to be an agent or employee of the University. Vendor and its employees and agents are not entitled to unemployment insurance or workers compensation benefits through the University and the University shall not pay for or otherwise provide such coverage for vendor or any of its agents or employees. Unemployment insurance benefits will be available to vendor and its employees and agents only if coverage is made available by vendor or a third party. Vendor shall pay when due all applicable employment, income, and local head taxes incurred pursuant to this PO. Vendor shall not have authorization, express or implied, to bind the University to any agreement, liability or understanding. Vendor shall (a) provide and keep in force workers' compensation and unemployment compensation insurance in the amounts required by law, (b) provide proof thereof when requested by the University, and (c) be solely responsible for its acts and those of its employees and agents.

16. Communication

All communication concerning administration of this PO, prepared by vendor for the University's use, shall be furnished solely to purchasing agent.

17. Compliance

Vendor shall strictly comply with all applicable federal and state laws, rules, and regulations in effect or hereafter established, including, without limitation, laws applicable to discrimination and unfair employment practices.

18. Insurance

Vendor shall obtain, and maintain, at all times during the term of this PO, insurance as specified in the solicitation, and provide proof of such coverage as requested by the University's purchasing agent.

19. Termination Prior to Shipment

If vendor has not accepted this PO in writing, the University may cancel this PO by written or oral notice to vendor prior to shipment of goods or commencement of services.
20. Termination for Cause

(a) If vendor refuses or fails to timely and properly perform any of its obligations under this PO with such diligence as will ensure its completion within the time specified herein, the University may notify vendor in writing of non-performance and, if not corrected by vendor within the time specified in the notice, terminate vendor’s right to proceed with the PO or such part thereof as to which there has been delay or a failure. Vendor shall continue performance of this PO to the extent not terminated and be liable for excess costs incurred by the University in procuring similar goods or services elsewhere. Payment for completed services performed and accepted shall be at the price set forth in this PO. (b) The University may withhold amounts due to vendor as the University deems necessary to reimburse the University for excess costs incurred in curing, completing or procuring similar goods and services. (c) If after rejection, revocation, or other termination of vendor’s right to proceed under the CUCC or this clause, the University determines for any reason that vendor was not in default or the delay was excusable, the rights and obligations of the University and vendor shall be the same as if the notice of termination had been issued pursuant to termination under § 21.

21. Termination in Public Interest

The University is entering into this PO for the purpose of carrying out the public policy of the State and University, as determined by the Governor, General Assembly and Courts of the State of Colorado and the University of Colorado Board of Regents. If this PO ceases to further the public policy of the State or University, the University, in its sole discretion, may terminate this PO in whole or in part and such termination shall not be deemed to be a breach of the University’s obligations hereunder. This section shall not apply to a termination for vendor’s breach, which shall be governed by Item 20 (Termination for Cause). The University shall give written notice of termination to vendor specifying the part of the PO terminated and when termination becomes effective. Upon receipt of notice of termination, vendor shall not incur further obligations except as necessary to mitigate costs of performance. For services or specially manufactured goods, the University shall pay (a) reasonable settlement expenses, (b) the PO price or rate for supplies and services delivered and accepted, (c) reasonable costs of performance on unaccepted supplies and services, and (d) a reasonable profit for the unaccepted work. For existing goods, the University shall pay (e) reasonable settlement expenses, (f) the PO price for goods delivered and accepted, (g) reasonable costs incurred in preparation for delivery of the undelivered goods, and (h) a reasonable profit for the preparatory work. The University’s termination liability under this section shall not exceed the total PO price plus a reasonable cost for settlement expenses. Vendor shall submit a termination proposal and reasonable supporting documentation, and cost and pricing data as required by CRS § 24-106-101, upon request of the University.

22. PO Approval

This PO shall not be valid unless it is executed by purchasing agent. The University shall not be responsible or liable for products or services delivered or performed prior to proper execution hereof.

23. Fund Availability

Financial obligations of the University payable after the current fiscal year are contingent upon funds for that purpose being budgeted and otherwise made available. If this PO is funded in whole or in part with federal funds, this PO is subject to and contingent upon the continuing availability of federal funds for the purposes hereof. The University represents that it has set aside sufficient funds to make payment for goods delivered in a single installment, in accordance with the terms of this PO.

24. Choice of Law

Colorado laws, rules and regulations shall be applied in the interpretation, execution, and enforcement of this PO. The CUCC shall govern this PO in the case of goods unless otherwise agreed in this PO. Any provision included or incorporated herein by reference which conflicts with such laws, rules, and
regulations is null and void. Any provision incorporated herein by reference which purports to negate this or any other provision in this PO in whole or in part shall not be valid or enforceable or available in any action at law, whether by way of complaint, defense, or otherwise. Unless otherwise specified in the solicitation or this PO, venue for any judicial or administrative action arising out of or in connection with this PO shall be in Denver, Colorado. Vendor shall exhaust administrative remedies in CRS § 24-109-106, prior to commencing any judicial action against the University.

25. Sensitive Data

To the extent vendors comes in contact with individual personal data owned or otherwise held by the University including employee, student, or medical information or records as a result of performing under this PO (“Data”), vendor agrees to use such Data, if at all, only to the extent required to perform its obligations under this PO, and to abide by the requirements of any federal, state and local laws that address the protection and/or use of such Data.

26. Background Checks

Contractor acknowledges that Contractor's activities may involve heightened risks as a result of access or exposure by Contractor's employees or agents to one or more Sensitive Environments. Contractor expressly acknowledges that Contractor shall take all commercially reasonable measures to mitigate any such risks, which measures may include but are not limited to conducting criminal history checks, financial background checks, or reference checks on employees or agents who will have access to one or more Sensitive Environments. For purposes of this provision, Sensitive Environment means any situation where Contractor's employees or agents: (a) are engaged in supervision of or exposure to minors or other vulnerable populations; (b) have access to confidential information, which includes any information protected or restricted by law or University policy or that is expressly identified by the University as confidential information; (c) have access to the University's information technology systems; (d) are engaged in activities that involve unique or specialized risks.

27. Public Contracts for Service

[Not Applicable to offer, issuance, or sale of securities, investment advisory services, fund management services, sponsored projects, intergovernmental POs, or information technology services or products and services] Vendor certifies, warrants, and agrees that it does not knowingly employ or contract with an illegal alien who will perform work under this PO and will confirm the employment eligibility of all employees who are newly hired for employment in the United States to perform work under this PO, through participation in the E-Verify Program or the Department program established pursuant to CRS § 8-17.5-102(5)(c), Vendor shall not knowingly employ or contract with an illegal alien to perform work under this PO or enter into a contract or PO with a subcontractor that fails to certify to vendor that the subcontractor shall not knowingly employ or contract with an illegal alien to perform work under this PO. Vendor shall (a) not use E-Verify Program or Department program procedures to undertake pre-employment screening of job applicants during performance of this PO, (b) notify subcontractor and the University within three days if vendor has actual knowledge that subcontractor is employing or contracting with an illegal alien for work under this PO, (c) terminate the subcontract if subcontractor does not stop employing or contracting with the illegal alien within three days of receiving notice, and (d) comply with reasonable requests made in the course of an investigation, undertaken pursuant to CRS § 8-17.5-102(5), by the Colorado Department of Labor and Employment. If vendor participates in the Department program, vendor shall deliver to the University a written, notarized affirmation that vendor has examined the legal work status of such employee, and shall comply with all of the other requirements of the Department program. If vendor fails to comply with any requirement of this provision or CRS § 8-17.5-101 et seq., the University may terminate this PO for breach and, if so terminated, vendor shall be liable for damages.

28. Public Contracts with Natural Persons
Vendor, if a natural person eighteen (18) years of age or older, hereby swears and affirms under penalty of perjury that he or she (a) is a citizen or otherwise lawfully present in the United States pursuant to federal law, (b) shall comply with the provisions of CRS § 24-76.5-101 et seq., and (c) has produced a form of identification required by CRS § 24-76.5-103 prior to the date vendor delivers goods or begins performing services under terms of the PO.

29. Governmental Immunity.

No term or condition of this contract shall be construed or interpreted as a waiver, express or implied, of any of the immunities, rights, benefits, protections, or other provisions, of the Colorado Governmental Immunity Act, CRS §24-10-101 et seq., or the Federal Tort Claims Act, 28 U.S.C. §§1346(b) and 2671 et seq., as applicable now or hereafter amended.


The signatories aver that to their knowledge, no employee of the University has any personal or beneficial interest whatsoever in the service or property described in this contract. Contractor has no interest and shall not acquire any interest, direct or indirect, that would conflict in any manner or degree with the performance of Contractor’s services and Contractor shall not employ any person having such known interests.

31. Federal Flowdown Provisions for Federally Funded Contracts

The University of Colorado has entered into an Agreement with either the U.S. Government, or another entity who has itself entered into an Agreement with the U.S. Government. That Agreement requires that certain federal contract provisions be made a part of any subsequent Purchase Order issued by the University of Colorado related to furthering the performance or deliverables required under that Agreement.

Where necessary to make the context of these provisions applicable to this order, the term "contractor" shall mean "seller," the term "contract" shall mean "this order," and the terms "Government," "contracting officer," and equivalent phrases shall mean "the University." Seller hereby agrees to flowdown the applicable clauses to its lower-tier subcontractors, and agrees that the clauses are in effect between it and the University, as applicable.

The following provisions are from the Federal Acquisition Regulations (FAR), which are available online. (NOTE: These FAR clauses may have applicability only when the Purchase Order is at or in excess of a certain dollar threshold, shown in parentheses, or under certain circumstances.)

<table>
<thead>
<tr>
<th>FAR Citation</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>52.203-6</td>
<td>Restrictions on Subcontractor Sales to the Government ($100,000)</td>
</tr>
<tr>
<td>52.203-7</td>
<td>Anti-Kickback Procedures except Subparagraph (c)(1) ($100,000)</td>
</tr>
<tr>
<td>52.203-12</td>
<td>Limitation on Payments to Influence Certain Federal Transactions ($100,000)</td>
</tr>
<tr>
<td>52.204-2</td>
<td>Security Requirements (applicable if access to classified material is involved) ($0)</td>
</tr>
<tr>
<td>52.215-2</td>
<td>Audit and Records -- Negotiation ($100,000)</td>
</tr>
<tr>
<td>52.215-10</td>
<td>Price Reduction for Defective Cost or Pricing Data ($550,000)</td>
</tr>
<tr>
<td>52.215-12</td>
<td>Subcontractor Cost or Pricing Data ($550,000)</td>
</tr>
<tr>
<td>52.215-13</td>
<td>Subcontractor Cost or Pricing Data -- Modifications ($550,000)</td>
</tr>
<tr>
<td>FAR Citation</td>
<td>Title</td>
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<tr>
<td>--------------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>52.215-14</td>
<td>Integrity of Unit Prices ($100,000)</td>
</tr>
<tr>
<td>52.219-8</td>
<td>Utilization of Small Business Concerns ($100,000)</td>
</tr>
<tr>
<td>52.219-9</td>
<td>Small Business and Small Disadvantaged Business Subcontracting Plans (Large Businesses) ($650,000)</td>
</tr>
<tr>
<td>52.219-16</td>
<td>Liquidated Damages -- Subcontracting Plan ($650,000)</td>
</tr>
<tr>
<td>52.222-4</td>
<td>Contract Work Hours and Safety Standards Act -- Overtime Compensation ($100,000)</td>
</tr>
<tr>
<td>52.222-21</td>
<td>Prohibition of Segregated Facilities ($10,000)</td>
</tr>
<tr>
<td>52.222-26</td>
<td>Equal Opportunity ($10,000)</td>
</tr>
<tr>
<td>52.222-35</td>
<td>Affirmative Action for Disabled Veterans and Veterans of the Vietnam Era ($25,000)</td>
</tr>
<tr>
<td>52.222-36</td>
<td>Affirmative Action for Workers with Disabilities ($10,000)</td>
</tr>
<tr>
<td>52.222-37</td>
<td>Employment Reports on Disabled Veterans and Veterans of the Vietnam Era ($25,000)</td>
</tr>
<tr>
<td>52.223-2</td>
<td>Clean Air and Water (applicable on orders issued under contracts solicited and issued prior to February 25, 2000)</td>
</tr>
<tr>
<td>52.223-6</td>
<td>Drug-Free Workplace (for individuals, $0; for non-individuals, $100,000)</td>
</tr>
<tr>
<td>52.223-7</td>
<td>Notice of Radioactive Materials (applicable if radioactive materials are involved) ($0)</td>
</tr>
<tr>
<td>52.223-14</td>
<td>Toxic Chemical Release Reporting ($100,000; N/A for acquisition of commercial items)</td>
</tr>
<tr>
<td>52.224-2</td>
<td>Privacy Act (applicable if vendor is supplying design, development, or operation of a system of records on individuals) ($0)</td>
</tr>
<tr>
<td>52.225-3</td>
<td>Buy American Act - Free Trade Agreements - Israeli Trade Act ($0)</td>
</tr>
<tr>
<td>52.225-13</td>
<td>Restrictions on Certain Foreign Purchases ($2,500)</td>
</tr>
<tr>
<td>52.226-1</td>
<td>Utilization of Indian Organizations and Indian-Owned Economic Enterprises ($0)</td>
</tr>
<tr>
<td>52.227-1</td>
<td>Authorization and Consent (applicable if in excess of the simplified acquisition threshold)</td>
</tr>
<tr>
<td>52.227-2</td>
<td>Notice and Assistance Regarding Patent and Copyright Infringement (applicable if in excess of the simplified acquisition threshold)</td>
</tr>
<tr>
<td>52.227-10</td>
<td>Filing of Patent Applications -- Classified Subject Matter ($0)</td>
</tr>
<tr>
<td>52.227-11</td>
<td>Patent Rights -- Retention by the Contractor (Short Form) ($0)</td>
</tr>
<tr>
<td>52.227-14</td>
<td>Rights in Data - General ($0)</td>
</tr>
<tr>
<td>52.230-5</td>
<td>Cost Accounting Standards -- Educational Institutions ($500,000)</td>
</tr>
<tr>
<td>52.230-6</td>
<td>Administration of Cost Accounting Standards ($500,000)</td>
</tr>
<tr>
<td>52.244-6</td>
<td>Subcontract for Commercial Items and Commercial Components ($0; non-commercial supplies or services)</td>
</tr>
</tbody>
</table>
In addition, if federal funds through a contract from an agency of the Department of Defense are involved, the following Department of Defense Federal Acquisition Regulations (DFAR) clauses apply. DFAR clauses are available online.

**(NOTE: These DFAR clauses may have applicability only when the Purchase Order is at or in excess of a certain dollar threshold, shown in parentheses, or under certain circumstances.**)

<table>
<thead>
<tr>
<th>DFAR Citation</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>252.203-7001</td>
<td>Prohibition on Persons Convicted of fraud or Other Defense-Contract Related Felonies (not applicable for commercial items) (applicable if at or in excess of the simplified acquisition threshold)</td>
</tr>
<tr>
<td>252.209-7000</td>
<td>Acquisition from Subcontractors Subject to On-Site Inspection Under the Intermediate Range Nuclear Forces (INF) Treaty (applicable if at or in excess of the simplified acquisition threshold) (not applicable for commercial items)</td>
</tr>
<tr>
<td>252.227-7013</td>
<td>Rights in Technical Data -- Noncommercial Items (0)</td>
</tr>
<tr>
<td>252.227-7014</td>
<td>Rights in Noncommercial Computer Software and Noncommercial Computer Software Documentation</td>
</tr>
<tr>
<td>252.227-7034</td>
<td>Patents - Subcontracts ($0, for experimental, developmental, or research work to be performed by other than a small business firm or non-profit organization)</td>
</tr>
<tr>
<td>252.231-7000</td>
<td>Supplemental Cost Principles (0)</td>
</tr>
</tbody>
</table>

In addition, if federal funds through a contract from the National Aeronautic and Space Administration (NASA) are involved, the following NASA Supplemental Federal Acquisition Regulations (FAR) clauses apply. NASA clauses are available online.

**(NOTE: These NASA clauses may have applicability only when the Purchase Order is at or in excess of a certain dollar threshold, shown in parentheses, or under certain circumstances.**)

<table>
<thead>
<tr>
<th>NASA Citation</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1852.208-81</td>
<td>Restrictions on Printing and Duplicating, Oct 2001 (0)</td>
</tr>
<tr>
<td>1852.219-74</td>
<td>Use of Rural Area Small Businesses, Sept 1990 (0)</td>
</tr>
<tr>
<td>1852.219-75</td>
<td>Small Business Subcontracting Reporting, May 1999 (500,000)</td>
</tr>
<tr>
<td>1852.223-70</td>
<td>Safety and Health, April 2002 ((1) Amount to $1,000,000 or more (unless Contracting Officer makes a written determination, after consultation with installation safety and health representatives, that this is not required); (2) Require construction, repair, or alteration in excess of $25,000; or (3) Regardless of dollar amount, involve the use of hazardous materials or operations.)</td>
</tr>
<tr>
<td>1852.227-70</td>
<td>New Technology, May 2002 (0, for the performance of experimental, developmental, or research work)</td>
</tr>
</tbody>
</table>
30. Federal Flowdown Provisions for Federally Funded Grants

The University of Colorado has entered into an Agreement with either the U.S. Government, or another entity who has itself entered into an Agreement with the U.S. Government. That Agreement requires that certain federal grant provisions be made a part of any subsequent Purchase Order issued by the University of Colorado related to furthering the performance or deliverables required under that Agreement.

Where necessary to make the context of these provisions applicable to this order, the term "contractor" shall mean "seller," the term "contract" shall mean "this order," and the terms "Government," "contracting officer," and equivalent phrases shall mean "the University." Seller hereby agrees to flowdown the applicable clauses to its lower-tier subcontractors, and agrees that the clauses are in effect between it and the University, as applicable.

Performance by the seller under this Purchase Order constitutes certification that the seller is presently in compliance with, and will continue to comply with, the Byrd Anti-Lobbying Amendment (31 U.S.C. 1352) and Executive Orders Numbers 12549 and 12689, all as described below.

Equal Employment Opportunity


All contracts and subgrants in excess of $2000 for construction or repair awarded by recipients and subrecipients shall include a provision for compliance with the Copeland "Anti-Kickback" Act (18 U.S.C. 874), as supplemented by Department of Labor regulations (29 CFR part 3, "Contractors and Subcontractors on Public Building or Public Work Financed in Whole or in Part by Loans or Grants from the United States"). The Act provides that each contractor or subrecipient shall be prohibited from inducing, by any means, any person employed in the construction, completion, or repair of public work, to give up any part of the compensation to which he is otherwise entitled. The recipient shall report all suspected or reported violations to the Federal awarding agency.

Davis-Bacon Act, as amended (40 U.S.C. 276a to a-7)

When required by Federal program legislation, all construction contracts awarded by the recipients and subrecipients of more than $2000 shall include a provision for compliance with the Davis-Bacon Act (40 U.S.C. 276a to a-7) and as supplemented by Department of Labor regulations (29 CFR part 5, "Labor Standards Provisions Applicable to Contracts Governing Federally Financed and Assisted Construction"). Under this Act, contractors shall be required to pay wages to laborers and mechanics at a rate not less than the minimum wages specified in a wage determination made by the Secretary of Labor. In addition, contractors shall be required to pay wages not less than once a week. The recipient shall place a copy of the current prevailing wage determination issued by the Department of Labor in each solicitation and the
award of a contract shall be conditioned upon the acceptance of the wage determination. The recipient shall report all suspected or reported violations to the Federal awarding agency.

**Contract Work Hours and Safety Standards Act (40 U.S.C. 327-333)**

Where applicable, all contracts awarded by recipients in excess of $2000 for construction contracts and in excess of $2500 for other contracts that involve the employment of mechanics or laborers shall include a provision for compliance with Sections 102 and 107 of the Contract Work Hours and Safety Standards Act (40 U.S.C. 327-333), as supplemented by Department of Labor regulations (29 CFR part 5). Under Section 102 of the Act, each contractor shall be required to compute the wages of every mechanic and laborer on the basis of a standard work week of 40 hours. Work in excess of the standard work week is permissible provided that the worker is compensated at a rate of not less than 1 1/2 times the basic rate of pay for all hours worked in excess of 40 hours in the work week. Section 107 of the Act is applicable to construction work and provides that no laborer or mechanic shall be required to work in surroundings or under working conditions which are unsanitary, hazardous or dangerous. These requirements do not apply to the purchases of supplies or materials or articles ordinarily available on the open market, or contracts for transportation or transmission of intelligence.

**Rights to Inventions Made Under a Contract or Agreement**

Contracts or agreements for the performance of experimental, developmental, or research work shall provide for the rights of the Federal Government and the recipient in any resulting invention in accordance with 37 CFR part 401, "Rights to Inventions made by Nonprofit Organizations and Small Business Firms Under Government Grants, Contracts and Cooperative Agreements," and any implementing regulations issued by the awarding agency.

**Clean Air Act (42 U.S.C. 7401 et seq.) and the Federal Water Pollution Control Act (33 U.S.C. 1251 et seq.), as amended**

Contracts and subgrants of amounts in excess of $100,000 shall contain a provision that requires the recipient to agree to comply with all applicable standards, orders or regulations issued pursuant to the Clean Air Act (42 U.S.C. 7401 et seq.) and the Federal Water Pollution Control Act as amended (33 U.S.C. 1251 et seq.). Violations shall be reported to the Federal awarding agency and the Regional Office of the Environmental Protection Agency (EPA).


Contractors who apply or bid for an award of $100,000 or more shall file the required certification. Each tier certifies to the tier above that it will not and has not used Federal appropriated funds to pay any person or organization for influencing or attempting to influence an officer or employee of any agency, a member of Congress, officer or employee of Congress, or an employee of a member of Congress in connection with obtaining any Federal contract, grant or any other award covered by 31 U.S.C. 1352. Each tier shall also disclose any lobbying with non-Federal funds that takes place in connection with obtaining any Federal award. Such disclosures are forwarded from tier to tier up to the recipient.

**Debarment and Suspension (E.O.s 12549 and 12689)**

No contract shall be made to parties listed on the General Services Administration's List of Parties Excluded from Federal Procurement or Nonprocurement Programs in accordance with E.O.s 12549 and 12689, "Debarment and Suspension." This list contains the names of parties debarred, suspended, or otherwise excluded by agencies, and contracts declared ineligible under statutory or regulatory authority other than E.O. 12549. Contractors with awards that exceed the small purchase threshold shall provide the required certification regarding its exclusion status and that of its principal employees.
**Access to Records (OMB Circular A-110, .48(d))**

All negotiated contracts (except those for less than the small purchase threshold) awarded by recipients shall include a provision to the effect that the recipient, the Federal awarding agency, the Comptroller General of the United States, or any of their duly authorized representatives, shall have access to any books, documents, papers, and records of the contractor which are directly pertinent to a specific program for the purpose of making audits, examination, excerpts and transcriptions.

31. Security Badging

All costs and time associated with obtaining a University security badge for Contractor employees working on campus shall be borne by the Contractor.
INSURANCE REQUIREMENTS (A)

Construction Purchase Order Insurance Requirements
University of Colorado Denver

For purposes of this supplement “Contractor” as used herein shall mean, as appropriate to the Contract form being used, Contractor, Standing Order Contractor or Construction Manager/General Contractor.

The Contractor shall obtain and maintain, at its own expense and for the duration of the contract including any warranty periods under the Contract are satisfied, the insurance coverages set forth below.

By requiring such insurance, the Principal Representative shall not be deemed or construed to have assessed the risk that may be applicable to the Contractor its agents, representatives, employees or subcontractors under this contract. The insurance requirements herein for this Contract in no way limit the indemnity covenants contained in the Contract. The Principal Representative in no way warrants that the limits contained herein are sufficient to protect the Contractor from liabilities that might arise out of the performance of the work under this Contract by the Contractor, its agents, representatives, employees, or subcontractors. The Contractor shall assess its own risks and if it deems appropriate and/or prudent, maintain higher limits and/or broader coverages. The Contractor is not relieved of any liability or other obligations assumed or pursuant to the Contract by reason of its failure to obtain or maintain insurance in sufficient amounts, duration, or types.

COVERAGES AND LIMITS OF INSURANCE - - Contractor shall provide coverage with limits of liability not less than those stated below.

1. Commercial General Liability – ISO CG 0001 or equivalent. Coverage to include:
   • Premises and Operations
   • Explosions, Collapse and Underground Hazards
   • Personal / Advertising Injury
   • Products / Completed Operations
   • Liability assumed under an Insured Contract (including defense costs assumed under contract)
   • Independent Contractors
   • Additional Insured—Owners, Lessees or Contractors Endorsement, ISO Form 2010 (2004 Edition or equivalent)
   • Additional Insured—Owners, Lessees or Contractors Endorsement (Completed Operations), ISO CG 2037 (7/2004 Edition or equivalent)
   • The policy shall be endorsed to include the following additional insured language on the Additional Insured Endorsements specified above: “The Regents of the University of Colorado, a Body Corporate, named as an additional insured with respect to liability and defense of suits arising out of the activities performed by, or on behalf of the Contractor, including completed operations”.

Page 1 of 7
• Commercial General Liability Completed Operations policies must be kept in effect for up to three (3) years after completion of the project.

<table>
<thead>
<tr>
<th>Liability Limits</th>
<th>General Aggregate</th>
<th>Products/Completed Operation Aggregate</th>
<th>Each Occurrence</th>
<th>Personal/Advertising Injury</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary General Liability</td>
<td>$2,000,000</td>
<td>$2,000,000</td>
<td>$1,000,000</td>
<td>$1,000,000</td>
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The following exclusionary endorsements are prohibited in the CGL policy:

1. Damage to work performed by subcontract/vendor (CG 22-94 or similar);
2. Contractual liability coverage exclusion modifying or deleting the definition of an “insured contract”;
3. If applicable to the work to be performed: Residential or multi-family;
4. If applicable to the work to be performed: Exterior insulation finish systems;
5. If applicable to the work to be performed: Subsidence or earth movement.

2. **Automobile Liability**

Bodily Injury and Property Damage for any owned, hired, and non-owned vehicles used in the performance of this contract

**Minimum Limits:**

Bodily Injury/Property Damage (Each Accident)  $1,000,000

3. **Workers Compensation**

• Statutory Benefits (Coverage A)
• Employers Liability (Coverage B)

  a. Policy shall contain a waiver of subrogation in favor of the Principal Representative.
  b. This requirement shall not apply when a contractor or subcontractor is exempt under Colorado Workers’ Compensation Act., AND when such contractor or subcontractor executes the appropriate sole proprietor waiver form.

**Minimum Limits:**

Coverage A (Workers’ Compensation)  Statutory
Coverage B (Employers Liability)  Each accident  $100,000
                                    Disease each employee  $100,000
                                    Disease policy limit  $500,000

4. **Contractors Pollution Liability**

• Coverage shall apply to sudden and gradual pollution conditions resulting from the escape of release of smoke, vapors, fumes, acids, alkalis, toxic chemicals, liquids, or
gases, natural gas, waste materials, or other irritants, contaminants, or pollutants (including asbestos). Policy shall cover the Contractor’s completed operations.

- If the coverage is written on a claims-made basis, the Contractor warrants that any retroactive date applicable to coverage under the policy precedes the effective date of this Contract; and that continuous coverage will be maintained or an extended discovery period will be exercised for a period of three (3) years beginning from the time that work under this contract is completed.

- **The policy shall be endorsed to include the following as Additional Insureds:**
  The Regents of the University of Colorado, a Body Corporate, named as an additional insured with respect to liability and defense of suits arising out of the activities performed by, or on behalf of the Construction Manager, including completed operations.

- Endorsements CA9948 and MCS-90 are required on the Automobile Liability Coverage if the Contractor is transporting any type of hazardous materials.

- **Contractors Pollution Liability policies must be kept in effect for up to three (3) years after completion of the project.**

**Minimum Limits:**

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<tbody>
<tr>
<td>Per Loss</td>
<td>$1,000,000</td>
</tr>
<tr>
<td>Aggregate</td>
<td>$1,000,000</td>
</tr>
</tbody>
</table>

5. **Professional Liability (Errors and Omissions)**
   *(This Professional Liability requirement applies only to Design/Build Projects.)*

- The Contractor shall maintain Errors and Omissions Liability covering negligent acts, errors and/or omissions, including design errors of the Contractor for damage sustained by reason of or in the course of operations under this Contract. The policy/coverages shall be amended to include the following:

  Amendment of any Contractual Liability Exclusion to state: “This exclusion does not apply to any liability of others which you assume under a written contract provided such liability is caused by your negligent acts.”

- In the event that any professional liability insurance required by this Contract is written on a claims-made basis, Contractor warrants that any retroactive date under the policy shall precede the effective date of this Contract; and that either continuous coverage will be maintained or an extended discovery period will be exercised for a period of three (3) years beginning at the time work under this Contract is completed.

- Policy shall contain a waiver of subrogation against The Regents of the University of Colorado, a Body Corporate.

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<tbody>
<tr>
<td>Wrongful Act</td>
<td>$2,000,000</td>
</tr>
<tr>
<td>General Aggregate</td>
<td>$2,000,000</td>
</tr>
</tbody>
</table>
6. **Builder’s Risk/ Installation Floater**

For projects of $100,000 or more or otherwise provided or instructed by the Principal Representative, the Contractor shall purchase and maintain, in a company or companies lawfully authorized to do business in the jurisdiction in which the project is located, Builder’s Risk Insurance in the amount of the initial contract amount as well as subsequent modifications for the entire project at the site on a replacement cost basis without optional deductibles. This coverage is required for new buildings or additions to existing buildings and for materials and equipment to be installed in existing structures.

- Covered Cause of Loss: Special Form
- Include Theft and Vandalism
- Labor costs to repair damaged work
- Shall be written for 100% of the completed value (replacement cost basis)
- Deductible maximum is $50,000.00
- Waiver of Subrogation is to apply
- The Regents of the University of Colorado, a body corporate, shall be added as Additional Named Insured on Builders Risk.

1. Policy must provide coverage from the time any covered property becomes the responsibility of the Contractor, and continue without interruption during construction, renovation, or installation, including any time during which the covered property is being transported to the construction installation site, or awaiting installation, whether on or off site.

2. The Policy shall be maintained, unless otherwise provided in the contract documents or otherwise agreed in writing by all persons and entities who are beneficiaries of such insurance, until final payment has been made or until no person or entity other than the Principal Representative has insurable interest in the property to be covered, whichever is later.

3. The Builder’s Risk insurance shall include interests of the Principal Representative, and if applicable, affiliated or associated entities, the General Contractor, subcontractors and sub-tier contractors in the project.

4. Builders’ Risk Coverage shall be on a Special Covered Cause of Loss Form and shall include theft, vandalism, malicious mischief, collapse, false-work, temporary buildings and debris removal including demolition, increased cost of construction, architect’s fees and expenses, flood (including water damage), earthquake, and if applicable, all below and above ground structures, piping, foundations including underground water and sewer mains, piling including the ground on which the structure rests and excavation, backfilling, filling, and grading. Equipment Breakdown Coverage (a.k.a. Boiler & Machinery) shall be included as required by the Contract Documents or by law, which shall specifically cover insured equipment during installation and testing (including hot testing, where applicable). Other coverages may be required if provided in contract documents.

5. The Builders’ Risk shall be written for 100% of the completed value (replacement cost basis) of the work being performed. The Builders’ Risk shall include the following provisions:
   a. Replacement Cost Basis - including modification of the valuation clause to cover all costs needed to repair the structure or work (including overhead and profits) and will
pay based on the values figured at the time of rebuilding or repairing, not at the time of loss

b. Modify or delete exclusion pertaining to damage to interior of building caused by an perils insured against are covered; also provide coverage for water damage

**Note, if the addition, or renovation is to an existing building, The Principal Representative requires that the Contractor provide as an option to include the existing building into the Builders’ Risk Policy. The Principal Representative shall provide the replacement cost value of the existing building**

6. At the option of the Principal Representative, the Principal Representative may include Soft Costs (including Loss of Use)/Delay in Opening Endorsement under the builder’s risk policy. The Principal Representative agrees to provide the necessary exposure base information for quotation by the Builder’s Risk carrier. The Principal Representative agrees to pay the premium associated with the Soft Costs coverage, the Principal Representative decides to purchase this coverage.

7. The Builders’ Risk Policy shall specifically permit occupancy of the building during construction. Partial occupancy or use of the work shall not commence until the insurance company or companies providing insurance have consented to such partial occupancy or use. The Principal Representative and Contractor shall take reasonable steps to obtain consent of the insurance company or companies and delete any provisions with regard to restrictions within any Occupancy Clauses within the Builders’ Risk Policy. The Builders’ Risk Policy shall remain in force until acceptance of the project by the Principal Representative.

8. The deductible shall not exceed $50,000 and shall be the responsibility of the Contractor except for losses such as flood (not water damage), earthquake, windstorm, tsunami, volcano, etc. Losses in excess of $50,000 insured shall be adjusted in conjunction with the Principal Representative. Any insurance payments/proceeds shall be made payable to the Principal Representative subject to requirements of any applicable mortgagee clause. The Contractor shall pay subcontractors their just shares of insurance proceeds received by the Contractor, and by appropriate agreements, written where legally required for validity, shall require subcontractors to make payments to their sub-subcontractors in similar manner.

The Principal Representative shall have the authority to adjust and settle any losses in excess of $50,000 with insurers unless one of the parties in interest shall object in writing within five days after occurrence of loss to the Principal Representative exercise of this power. It is expressly agreed that nothing in this section shall be subject to arbitration and any references to arbitration are expressly deleted.

9. The Contractor is responsible for providing 45 days’ notice of cancellation to the Principal Representative. The policy shall contain all generally applicable conditions, definitions, exclusions and endorsements related to the Project.

If the Contractor does not intend to purchase such Builder’s Risk Insurance required by the Contract and with all of the coverages in the amount described above, the Contractor shall so inform the Principal Representative as stated in writing prior to commencement of the work. The Principal Representative may then affect insurance that will protect the interests of the Principal Representative, the General Contractor, Subcontractors and sub-tier contractors in the project. Coverages applying shall be the same as stated above including other coverages that may be required by the Principal Representative. The cost shall be
charged to the Contractor. Coverage shall be written for 100% of the completed value of the work being performed, with a deductible not to exceed $50,000 per occurrence for most projects.
All deductibles will be assumed by the Contractor. Waiver of Subrogation is to apply against all parties named as insureds, but only to the extent the loss is covered, and Beneficial Occupancy Endorsements are to apply.
If the Principal Representative is damaged by the failure or neglect of the Contractor to purchase or maintain insurance as described above, without so notifying the Principal Representative, then the Contractor shall bear all reasonable costs properly attributable thereto.

ADDITIONAL INSURANCE REQUIREMENTS

1. All insurers must be licensed or approved to do business within the State of Colorado, and unless otherwise specified, all policies must be written on a per occurrence basis.
2. Contractor’s insurance carrier should possess a minimum A.M. Best’s Insurance Guide rating of A- VI.
3. On insurance policies where the Principal Representative are named as additional insureds, the Principal Representative shall be additional insureds to the full limits of liability purchased by the Contractor even if those limits of liability are in excess of those required by this Contract.
4. Contractor shall furnish the Principal Representative with certificates of insurance (ACORD form or equivalent approved by the Principal Representative) as required by this Contract. The certificates for each insurance policy are to be signed by a person authorized by that insurer to bind coverage on its behalf.
All certificates and any required endorsements are to be received and approved by the Principal Representative before work commences. Each insurance policy required by this Contract must be in effect at or prior to commencement of work under this Contract and remain in effect for the duration of the project. Failure to maintain the insurance policies as required by this Contract or to provide evidence of renewal is a material breach of contract.
5. Upon request by the Principal Representative, Contractor must provide a copy of the actual insurance policy effecting coverage(s) required by the contract.
6. The Contractor’s insurance coverage shall be primary insurance and non-contributory with respect to all other available resources.
7. The Contractor shall advise the Principal Representative in the event any general aggregate or other aggregate limits are reduced below the required per occurrence limit. At their own expense, the Contractor will reinstate the aggregate limits to comply with the minimum requirements and shall furnish to the Principal Representative a new certificate of insurance showing such coverage is in force.
8. Provide a minimum of thirty (30) days advance written notice to the Principal Representative for cancellation, non-renewal, or material changes to policies required under the Contract (45 days for builders’ risk coverage.

Failure of the Contractor to fully comply with these requirements during the term of the Contract may be considered a material breach of contract and may be cause for immediate termination of
the Contract at the option of the Principal Representative. The Principal Representative reserves the right to negotiate additional specific insurance requirements at the time of the contract award.

**Subcontractors**
Contractor’s certificate(s) shall include all subcontractors as additional insureds under its policies or subcontractors shall maintain separate insurance as determined by the Contractor, however, subcontractor's limits of liability shall not be less than $1,000,000 per occurrence / $2,000,000 aggregate.

**Non-Waiver**
The parties hereto understand and agree that The Principal Representative is relying on, and does not waive or intend to waive by any provision of this Contract, the monetary limitations or any other rights, immunities, and protections provided by the Colorado Governmental Immunity Act, et seq., as from time to time amended, or otherwise available to the Principal Representative or its officers, employees, agents, and volunteers.

**Mutual Cooperation**
The Principal Representative and Contractor shall cooperate with each other in the collection of any insurance proceeds which may be payable in the event of any loss, including the execution and delivery of any proof of loss or other actions required to effect recovery.

_**Revised March 12, 2012 MB**_
NEW AUTOMATED SERVICES FOR AND ABOUT BUSINESSES

The Colorado Department of Revenue Sales Tax Information System provides the following automated services:

* Colorado Sales Tax Rates - find specific city, county and special district rates.
* Verification of Sales Tax License Exemption Numbers - determine whether a Colorado sales tax license or exemption certificate is valid.
* Tax Rates by Account Number - find sales tax rates and locations for specific sales tax accounts.

These services make it possible for taxpayers to help themselves to information 24 hours a day - without requiring the assistance of a customer service representative. In this way, more complicated or confidential tax information inquiries can be reserved for speaking to a live agent.

Listen and look for these services on the department's business tax information phone line at 303-238-FAST (3278) for specific account information, 303-238-SERV (7378) for general information or the DOR Web site at www.taxcolorado.com

Web users can try the new system online at www.taxview.state.co.us. We are interested in your comments about the system. You can send us an e-mail with your comments through our Department of Revenue Web site.
SALES TAX EXEMPTION CERTIFICATE
MULTI - JURISDICTION

Issued to (Saler)

Name of Firm (Saler)
Regents of University of Colorado

Street Address or Post Office Box Number
1800 Grant Street, Suite 600

City
Denver

State
CO

ZIP Code
80203

☐ WHOLESALE
☐ RETAILER
☐ MANUFACTURER
☐ LESSOR (See note on reverse side)
☐ CHARITABLE OR RELIGIOUS

☐ POLITICAL SUBDIVISION OR GOVERNMENTAL AGENCY
☐ OTHER (Specify)

1) and is registered with the below listed states and cities within which your firm would deliver purchases to us which are for resale or lease by us in the normal course of our business which is: ____________________________ or

2) that such purchases are exempt from payment of sales or use tax in such states and cities because our buyer is: ☐ CHARITABLE OR RELIGIOUS

☐ POLITICAL SUBDIVISION OR GOVERNMENTAL AGENCY
☐ OTHERWISE EXEMPT BY STATUTE (SPECIFY)

City or State
City of Aurora
State Registration or ID Number
98-00799-0000

City of State
Colorado
State Registration or ID Number
98-02915

If the list of states and cities is more than six (6), attach a list to this certificate.

I further certify that if any property so purchased tax free is used or consumed by the firm as to make it subject to a Sales or Use Tax we will pay the tax due direct to the proper taxing authority when state law so provides or inform the seller for added tax billing. This certificate shall be part of each order which we may hereafter give to you, unless otherwise specified, and shall be valid until cancelled by us in writing or revoked by the city or state.

General description of products to be purchased from the seller

Under penalties of perjury, I swear or affirm that the information on this form is true and correct as to every material matter.

Authorized Signature (Owner, Partner or Corporate Officer)

Associate Vice President and University Controller

Date
7/25/2008
March 12, 2001

Wayne F. Henderson
Vice Chancellor for Administration and Finance
University of Colorado Health Sciences Center
Fitzsimons, Building 500, Room C1003
P.O. Box 6508
Aurora, Colorado 80045-0508

RE: Letter of Commitment

Dear Mr. Henderson:

I am in receipt of your letter dated February 27, 2001, requesting that I issue a letter of commitment to the University of Colorado Health Sciences Center ("UCHSC") pursuant to City Code Section 130-63(c). It is my understanding that UCHSC is part and parcel of the University of Colorado, a public institution of higher education of the State of Colorado. § 23-20-101, et seq., C.R.S. You have asked for some assurance that UCHSC is exempt from the payment of City sales and use tax, as well as the employer portion of the City occupational privilege tax.

City Code Section 130-157(1) exempts all sales of tangible personal property and taxable services to the various political subdivisions of this state from imposition of City sales tax. Identical exemptions exist in both the City Use Tax ordinance (City Code § 130-198(5)) and the City Employer Occupational Privilege Tax ordinance (City Code § 130-405(1)). Accordingly, UCHSC falls squarely within each of these three exemptions.

It should be noted, however, that these exemptions do not extend to the collection of City tax. For instance, UCHSC must collect, report, and remit City sales tax on any retail sale of tangible personal property or taxable services it makes to a non-exempt third party. City Code § 130-160. Likewise, UCHSC
must also collect, report, and remit the employee portion of the City occupational privilege tax for each person it employs within the City for any period of time within a calendar month sufficient to receive no less than $250.00 as compensation for such employment. City Code § 130-464.

With respect to the deposit and ultimate payment of City use tax on construction materials, it is the longstanding policy of the City that the party who contracts for and directs and controls the construction of building improvements is liable for such tax. See Fifteenth Street Investment Co. v. People, 102 Colo. 571, 81 P.2d 764 (1938). Under the circumstances described in your request, it is UCHSC, and not its contractors, upon whom sole liability for the payment of City use tax would rest. Because UCHSC is an exempt entity, no use tax is due and owing on the purchase and subsequent use of construction materials for the development of UCHSC's property at the Fitzsimons site.

With regard to your additional requests, the City has no objection if UCHSC's contractors wish to use this letter to present to City building officials and third-party retailers as evidence of UCHSC's tax exemption. As for any future revocation of this letter, unless the status of UCHSC as a political subdivision changes, the various City tax exemptions which UCHSC is entitled to claim cannot be lawfully repealed without the prior approval of the City's voters. See Colo. Const. Art. X, § 20(4)(a). Therefore, the City believes UCHSC will be adequately informed in the event that the City decides to seek approval for any change in its tax laws that would impact UCHSC's tax-exempt status.

Very truly yours,

[Signature]

John Gross
Director of Finance
November 5, 1999

University of Colorado Procurement Service Center
Fitzsimons Building 500 Rm. B4325
Mail Stop F 719
P.O. Box 6508
Aurora, CO 80045

Ladies/Gentlemen:

The University of Colorado Procurement Service Center is exempt from the Denver sales tax per Sec. 53-26 (1) of the City Retail Sales Tax Article:

Sec. 53-26(1) Exemptions.

There shall be exempt from taxation under the provisions of this Article the following:
(1) All sales to the United States Government, to the State, its departments and institutions and the political subdivisions thereof, only when purchased in their governmental capacities.

To qualify for the exemption, purchases must be billed direct to the organization, and payment made from funds of the organization.

The exemption does not extend to construction contractors who may perform contracts for you; they are the consumer of all property purchased and used in the performance or contracts for others. Nor does the exemption apply to purchases by employees or members for their own personal use.

You may reproduce this letter to furnish to suppliers as needed.

Sincerely,

[Signature]
Scott Sprague, Audit Manager
Tax Compliance Audit Section
(303) 640-3484
Michael J. Barden
University of Colorado at Denver and Health Sciences Center (UCDHSC)
Building 500, Mail Stop F418
P.O. Box 6508
Aurora CO 80045

April 7, 2006

Dear Mr. Barden:

This is in response to your letter of March 1, 2006, to Bruce Nelson of the Department of Revenue regarding sales tax exemption from county and special district sales taxes for UCDHSC construction projects at the Fitzsimons campus. Mr. Nelson has left the Department, so I am responding to your inquiry.

In regards to Adams County sales and use tax, the sales tax is collected by the Department of Revenue, not the city of Aurora. Use tax on building materials is collected by the county when issuing building permits. Under 29-2-105(d), 39-26-708(1)(a) and 39-26-708(2)(a), C.R.S., UCDHSC and its contractors and sub-contractors are exempt from county sales and use tax on construction and building materials for State/UCDHSC owned real property.

In regards to special district sales and use taxes, UCDHSC and its contractors and sub-contractors are exempt from sales and use tax pursuant to the exemptions granted in 39-26-708(1)(a) and 39-26-708(2)(a), C.R.S., for the Regional Transportation District under 32-9-119(2)(c)(I), C.R.S., for the Scientific and Cultural District under 32-13-107(2), C.R.S., and for the Metropolitan Football Stadium District under 32-15-110(2)(a), C.R.S.

Additionally, for construction projects in the City and County of Denver, UCDHSC and its contractors and sub-contractors are exempt from the aforementioned special district sales and use taxes, as well as state sales and use tax.

Should you have additional questions regarding these matters, feel free to contact me.

Respectfully,

Steve Asbell
Taxpayer Service Policy Group
Colorado Dept of Revenue
Ph: 303.866.3889 email: sasbell@spike.dor.state.co.us
CONTRACTOR APPLICATION FOR EXEMPTION CERTIFICATE
Pursuant to Statute
Section 39-26.708(1)(a)(XIX)

The exemption certificate for which you are applying must be used only for the purpose of purchasing construction and building materials for the exempt project described below. This exemption does not include or apply to the purchase or rental of equipment, supplies, and materials which are purchased, rented, or consumed by the contractor and which do not become a part of the structure, highway, road, street, or other public works owned and used by the exempt organization.

Any unauthorized use of the exemption certificate will result in revocation of your exemption certificate and other penalties provided by law.

A separate certificate is required for each contract.

Subcontractors will not be issued Certificates of Exemption by the Department of Revenue. It is the responsibility of the prime contractor to issue certificates to each of the subcontractors. (See reverse side.)

SEND COMPLETED FORMS TO: COLORADO DEPARTMENT OF REVENUE, DENVER, CO 80261

FAILURE TO ACCURATELY COMPLETE ALL BOXES WILL CAUSE THE APPLICATION TO BE DENIED.

<table>
<thead>
<tr>
<th>Contractor/Account No. (Leave blank if filing for the first time)</th>
<th>Period</th>
<th>Contractor/Account No. (Leave blank if filing for the first time)</th>
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<tr>
<td>89 -</td>
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<td>0170-750 (999) $0.00</td>
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CONTRACTOR INFORMATION

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<th>Trade name/DBA:</th>
<th>Owner, partner, or corporate name:</th>
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<tr>
<th>Mailing address (City, State, Zip):</th>
<th>Contact Person</th>
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<tr>
<th>E-Mail address:</th>
<th>Federal Employer's Identification Number:</th>
<th>Bid amount for your contract:</th>
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<tr>
<th>Fax number:</th>
<th>Business telephone number:</th>
<th>Colorado withholding tax account number:</th>
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EXEMPTION INFORMATION

Copies of contract or agreement pages, identifying the contracting parties, bid amount, type of work, and signatures of contracting parties MUST be attached.

<table>
<thead>
<tr>
<th>Name of exempt organization (as shown on contract):</th>
<th>Exempt organization's number:</th>
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<tbody>
<tr>
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<td>98 -</td>
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<tr>
<th>Address of exempt organization (City, State, Zip):</th>
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<tr>
<th>Principal contact at exempt organization:</th>
<th>Principal contact's telephone number:</th>
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<tr>
<th>Physical location of project site (give actual address when applicable and Cities and/or County (ies) where project is located)</th>
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<tr>
<th>Scheduled construction start date:</th>
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<th>Day</th>
<th>Year</th>
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<tr>
<th>Estimated completion date:</th>
<th>Month</th>
<th>Day</th>
<th>Year</th>
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I declare under penalty of perjury in the second degree that the statements made in this application are true and complete to the best of my knowledge.

Signature of the business owner, partner or corporate officer:  
Title of corporate officer:  
Date:

DO NOT WRITE BELOW THIS LINE
Special Notice

Contractors who have completed this application in the past, please note the following changes in procedure:

The Department will no longer issue individual Certificates of exemption to subcontractors. Only prime contractors will receive a Contractor's Exemption Certificate on exempt projects.

Upon receipt of the Certificate, the prime contractor should make a copy for each subcontractor involved in the project and complete it by filling in the subcontractor's name and address and signing it.

The original Certificate should always be retained by the prime contractor. Copies of all Certificates that the prime contractor issued to subcontractors should be kept at the prime contractor's place of business for a minimum of three years and be available for inspection in the event of an audit.

Once an 89# has been assigned to you, please use the next five numbers following it for any applications submitted for future projects. This should be your permanent number. For instance, if you were assigned 89-12345-0001, every application submitted thereafter should contain 89-12345 on the application. The succeeding numbers will be issued by the Department of Revenue. DO NOT enter what you believe to be the next in sequence as this may delay processing of your application.
PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes the following:
1. Demolition and removal of selected portions of building or structure.
2. Salvage of existing items to be reused or recycled.

B. Related Sections:
1. Division 01 Section "Indoor Air Quality Procedures".
2. Division 01 Section "Temporary Facilities and Controls" for temporary construction and environmental-protection measures for selective demolition operations.
3. Division 01 Section "Photographic Documentation" for pre-demolition photographs.
4. Division 01 Section "Execution" for cutting and patching procedures.

1.02 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Salvage: Detach items from existing construction and deliver them to Owner.

C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.

D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.03 ACTION SUBMITTALS

A. Schedule of Selective Demolition Activities: Indicate the following:
1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's building managers and other tenants' on-site operations are uninterrupted.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Use of elevator and stairs.
5. Locations of proposed dust-and noise-control temporary partitions and means of egress, including for other tenants affected by selective demolition operations.
6. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
7. Means of protection for items to remain and items in path of waste removal from building.
B. Inventory: After selective demolition is complete, submit a list of items that have been removed and salvaged.

C. Pre-demolition Photographs or Video Recordings: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by selective demolition operations.

1.04 QUALITY ASSURANCE

A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.

B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

C. Standards: Comply with ANSI A10.6 and NFPA 241.

D. Pre-demolition Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination. Review methods and procedures related to selective demolition including, but not limited to, the following:

1. Inspect and discuss condition of construction to be selectively demolished.
2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.

1.05 PROJECT CONDITIONS

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

1. Comply with requirements specified in Division 01 Section "Summary".

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials: Will be identified by Owner’s asbestos consultant on walk through with contractor to identify test areas for asbestos removal.

1. If unsuspected materials containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner.

E. Storage or sale of removed items or materials on-site is not permitted.
F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
   1. Maintain fire protection facilities in service during selective demolition operations.

1.06 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that utilities have been disconnected and capped.

B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.

D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

E. Survey of Existing Conditions: Record existing conditions by use of measured drawings preconstruction photographs and preconstruction video tapes plates.
   1. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.
   2. Comply with requirements specified in Division 01 Section "Photographic Documentation."

F. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.
3.02 UTILILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems: Maintain services/systems indicated to remain and protect them against damage during selective demolition operations.

B. Comply with requirements for existing services/systems interruptions specified in Division 01 Section "Summary".

C. Service/System Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
   1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
   2. Arrange to shut off indicated utilities with utility companies.
   3. If services/systems are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary services/systems that by pass area of selective demolition and that maintain continuity of services/systems to other parts of building.
   4. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after by passing.
      a. Where entire wall is to be removed, existing services/systems may be removed with removal of the wall.

3.03 PREPARATION

A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
   1. Comply with requirements for access and protection specified in Division 01 Sections "Temporary Facilities and Controls".

B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
   1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
   2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
   3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
   4. Cover and protect furniture, furnishings, and equipment that have not been removed.
   5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Division 01 Section "Temporary Facilities and Controls."

C. Comply with requirements for protection of existing ductwork and air distribution system as specified in Division 01 Section "Indoor Air Quality Procedures".
3.04 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limit at ions of governing regulations and as follows:
   1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimized disturbance of adjacent surfaces. Temporarily cover openings to remain.
   2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
   3. Do not use cutting torches until work area is cleared off flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppress ion devices during flame-cutting operations.
   4. Maintain adequate ventilation when using cutting torches.
   5. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
   6. Dispose of demolished items and materials promptly.

B. Removed and Salvaged Items:
   1. Clean salvaged items.
   2. Pack or crate items after cleaning. Identify contents of containers.
   3. Store items in a secure area until delivery to Owner.
   4. Transport items to Owner's storage area designated by Owner.
   5. Protect items from damage during transport and storage.

C. Removed and Reinstalled Items:
   1. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
   2. Pack or crate items after cleaning and repairing. Identify contents of containers.
   3. Protect items from damage during transport and storage.
   4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.
3.05 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in small sections. Cut concrete to a depth of at least 3/4-inch at junctures with construction to remain, using power driven saw. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete indicated for selective demolition. Neatly trim openings to dimensions indicated.

B. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings." Do not use methods requiring solvent-based adhesive strippers.
   1. Remove residual adhesive and prepare substrate for new floor coverings by one of the methods recommended by RFCI.

C. Air-Conditioning Equipment: Remove equipment without releasing refrigerants.

3.06 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

3.07 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.
   1. Do not allow demolished materials to accumulate on-site.
   2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
   3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
   4. Comply with requirements specified in Division 01 Section "Construction Waste Management and Disposal."

B. Burning: Do not burn demolished materials.

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

END OF SECTION
PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes the following:
1. General requirements for all Division 23 sections
2. Piping materials and installation instructions common to most piping systems
3. Access Panels
4. Identification
5. HVAC demolition
6. Equipment installation requirements common to equipment sections
7. Painting and finishing
8. Supports and anchorages

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specifications, apply to this Section.

B. All electrical work installed under Division 23 shall be in compliance with Division 26.

1.03 DRAWINGS AND SPECIFICATIONS

A. The drawings are diagrammatic in character indicating design concept and do not indicate every required duct or piping offset, valve, fitting, etc.

B. All drawings relating to this structure, together with these specifications, shall be considered in bidding and construction. The drawings and specifications are complementary, and what is called for in either of these shall be as binding as though called for by both. Should any conflict or omissions arise between the drawings and specifications, such conflict shall be brought to the attention of the Architect/Engineer for resolution.

C. Unless otherwise indicated, all equipment and performance data listed is for job site conditions (elevation 5300 feet).

D. Drawings are not to be scaled.

1.04 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:
   1. CPVC: Chlorinated polyvinyl chloride plastic
   2. PE: Polyethylene plastic
   3. PVC: Polyvinyl chloride plastic

G. The following are industry abbreviations for rubber materials:
   1. EPDM – Ethylene propylene diene terpolymer rubber
   2. NBR – Acrylonitrile-butadiene rubber

1.05 SUBMITTALS

A. Division 23 Submittal Data and Shop Drawings:
   1. Refer to Division 1, for general submittal requirements.
   2. Contractor agrees that shop drawings and/or submittals processed by the Engineer are not change orders; that the purpose of shop drawings and/or submittals by the Contractor is to inform the Engineer which equipment and materials he intends to furnish and install.
   3. Submittals and/or shop drawings are to be edited to show specific data and all options for the HVAC equipment that the Contractor intends to provide.
   4. Submittals and/or shop drawings are to be identified with numbers or letters identical to those listed on the drawings and/or specifications.
   5. All shop drawings for special systems (temperature controls, etc.) that will become permanent record documents shall be prepared on AutoCAD Version 2007 or later, using the same drawing size as the project construction documents.
   6. Approved Manufacturers and Substitutions
      a. Equipment and/or materials manufactured by any one of the Engineer-approved manufacturers listed in this specification or on the drawings shall be acceptable if the equipment and material is equivalent in performance, capacity, and configuration.
      b. Substitution Requests prior to bid: Refer to Division 1. No prior approvals will be given by the Engineer unless specifically mentioned in these specifications.
      c. Substitution Requests after Execution of Contract: If Contractor wishes to furnish or use a substitute item of material and/or equipment, he must submit a change order request to the Engineer. The request for change order shall itemize each of the proposed substitutions identified by applicable specification section, paragraph number, and/or drawing number. A price change (increase or decrease) shall be listed for each item along with complete data showing performance over entire range, physical dimensions, electrical characteristics, material construction, operating weight, and other applicable data. Justification of substitution must be more than just cost justification. The Engineer will review the change order request for equality, suitability, and reasonableness of price differential. A single substitution change order listing the approved items will be issued with the net cost of the change order being the sum of the approved item costs. No subsequent substitution change orders will be considered. The Engineer’s decision will be final.
      d. It shall be the responsibility of the Contractor to assure that the substitute material and/or equipment fits into the space provided and the Contractor shall pay for all extra costs incurred by other trades for any and all changes necessitated by these substitutions. No time extension will be allowed due to substitution on equipment.
e. Equipment and/or materials manufactured by any one of the Engineer-approved manufacturers listed in this specification or on the drawings shall be acceptable if the equipment and material is equivalent in performance, capacity, and configuration.

7. Submittals Schedule:
   a. Comply with Division 1 construction progress documentation and submittal requirements and the additional submittal requirements specified below. Unless otherwise specified in Division 1, comply with the submittal periods specified below. Engineer will schedule submittal reviews based upon submittal schedule. Failure to submit schedule may result in inability to review submittals within the periods stated in the submittal schedule. These delays shall not be cause for extension of Contact completion date.
      1) Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect’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.
      2) Submit schedule within 14 days of commencement of work. Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
      3) Allow 15 days for review of each resubmittal.
      4) Submit a minimum of three copies of schedule. Arrange the following information in a tabular format:
         a) Scheduled date for first submittal.
         b) Specification Section number and title.
         c) Submittal category (action or informational).
         d) Name of subcontractor.
         e) Description of the Work covered.
         f) Scheduled date for Architect’s final release of reviewed submittal.

8. Schedule of Deviations
   a. Equipment and material submittals of approved manufacturers, including basis of design manufacture shall provide a written itemization of exceptions to the specification and deviations from the basis of design for all features, design, configuration, physical dimension, performance, and operation of the submitted product. Those elements not identified and itemized as exceptions in the submittal shall not be reviewed by the Engineer and shall be provided as specified.

B. Close-out Submittals:
1. Operating and Maintenance (O&M) Manual:
   a. Provide O&M manuals in accordance with Division 1.
   b. The Contractor shall prepare an operating and maintenance manual that shall cover all systems and equipment installed under this Division. Incorporate the standard technical literature into system-specific formats for this facility as designed and actually installed. The resulting manual shall also serve as the training manual and shall be specific, concise, to the point, and tailored specifically for this facility.
   c. Unless specified otherwise in Division 1, the maintenance manual shall be submitted to the Engineer in draft form for approval prior to preparation of two copies for final submission to the Architect for delivery to the Owner.
   d. The maintenance manual shall be 8-1/2” x 11” size and assembled in loose-leaf three-ring or post binder. Provide manufacturers’ original literature. Facsimiles are not acceptable. The manual shall be adequately indexed and contain the following information:
      1) Contractors’ names, addresses, and telephone numbers
      2) Alphabetical list of all system components with the name and address and 24-hour phone number of the company responsible for servicing each item during the first year of operation
3) Guarantees and warranties of all equipment whenever applicable.
4) All manufacturers’ data that is applicable to the installed equipment, with appropriate highlighting, such as the following:
   a) Shop drawings (latest copy)
   b) Installation instructions
   c) Lubrication instructions
   d) Wiring diagrams
5) A simplified description of the operation of all systems including the function of each piece of equipment within each system, including both normal and emergency operation. These descriptions shall be supported with a schematic flow diagram when applicable.

2. Record Drawings
   a. Comply with record drawing requirements in Division 1.
   b. Record Prints
      1) All RFIs, change orders and other directives if not recorded on the contract drawings and amendments shall be red-lined on the record drawings. Record drawings simply tabulating the amendments onto the drawings shall be returned for clarification of installed conditions and red-line mark-up.

C. Non-Responsive Submittals: Submittals are intended to be reviewed in an initial submittal with comments corrected and submitted in a resubmittal. Non-responsiveness to the initial submittal comments in the resubmittal will result in return of the documents for correction and additional resubmittals. Any time charged by the Engineer in review of additional resubmittals due to non-responsiveness shall be deducted from the Contractor's billings.

D. Product Data: for the following:
   1. Transition fittings
   2. Dielectric fittings
   3. Mechanical sleeve seals
   4. Escutcheons
   5. Motor Submittal Data: The following data shall be submitted for all motors:
      a. Full load current and service factor running current at operating voltage.
      b. Locked rotor current, starting power factor, and power factor at full load.
      c. Efficiency at full load.
      d. Data to substantiate Class F insulation with Class B rise at 100% load.
      e. Full load speeds (rpm).
      f. Enclosure type (ODP, TEFC, explosion proof, TENV, WPI, etc.)
         Note: All tests (except locked rotor current) shall be made at full voltage and rated frequency.
   6. Motor Controllers:
      a. Torque, speed, and horsepower requirements of the load.
      b. Ratings and characteristics of supply circuit and required control sequence.
      c. Ambient and environmental conditions of installation location.
   7. Capacitor size (KVAR) for maximum power factor correction at 95% lagging.
   8. Identification: Submit product for each type of identification.

E. Certification:
   1. Welding certificates
   2. Certificates of Compliance for all Designated Seismic Systems.

F. Schedules:
   1. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
   2. Valve numbering scheme.
   3. Valve Schedules: For each piping system to include in maintenance manuals.
1.06 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
   1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
   2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for HVAC Equipment: Equipment of lower or higher electrical characteristics may be furnished provided such proposed equipment variations are specifically identified as a deviation from contract documents and approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified at no cost to the Owner. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support piping to prevent sagging and bending.

1.08 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 8.

D. Identification:
   1. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
   2. Coordinate installation of identifying devices with locations of access panels and doors.
   3. Install identifying devices before installing acoustical ceilings and similar concealment.

E. Coordinate with all trades to maintain clearances to access panels, equipment, control and electrical panels. Intrusions into access space shall be brought to the attention of other trades. Notify Engineer of conflicts shown on drawings prior to installation.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
   1. Subject to compliance with requirements, provide products by the manufacturers specified.
2.02 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 23 HVAC piping Sections for pipe, tube, and fitting materials and joining methods.
   1. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.03 JOINING MATERIALS

A. Refer to individual Division 23 HVAC piping Sections for special joining materials not listed below.

B. Solder Filler Metals: ASTM B32, lead-free alloys. Include water-flushable flux according to ASTM B813.

C. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

D. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.04 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Use dielectric couplings.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150 or 300 psig (1035 or 2070 kPa) minimum working pressure as required to suit system pressures.
   1. Available Manufacturers:
      a. Capitol Manufacturing Co.
      b. Central Plastics Company
      c. Epco Sales, Inc.
      d. Watts Industries, Inc.; Water Products Division

E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
   1. Available Manufacturers:
      a. Advance Products & Systems, Inc.
      b. Calpico, Inc.
      c. Central Plastics Company
      d. Pipeline Seal and Insulator, Inc.
   2. Separate companion flanges and steel bolts and nuts shall have 150 or 300 psig (1035 or 2070 kPa) minimum working pressure where required to suit system pressures.

F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300 psig (2070 kPa) minimum working pressure at 225°F (107°C).
   1. Available Manufacturers:
      a. Calpico, Inc.
      b. Lochinvar Corp.
2.05 MISCELLANEOUS ELECTRICAL DEVICES

A. Furnish all necessary control devices such as speed controls, transformers, and relays as required for proper operation of all equipment furnished under this Division.

B. Furnish all remote switches and/or pushbutton stations required for manually operated equipment complete with low energy pilot lights of an approved type.

C. Enclosures: NEMA Type 1, general purpose enclosures with padlock ears, except in wet locations shall be NEMA Type 4 with conduit hubs, or units in hazardous locations that shall have NEC proper class and division explosion proof enclosure.

D. Furnish circuit and purpose identification for each remote manual switch and/or pushbutton station furnished herein. Identification may be either engraved plastic sign for permanent mounting to wall below switch, or stamping on switch coverplate. All such identification signs and/or switch covers in finished areas shall match other hardware in the immediate area.

2.06 ACCESS PANELS OTHER THAN SHEET METAL

A. Refer to Division 8 for specification of access doors.

2.07 IDENTIFICATION

A. Equipment Labels:

1. Metal Labels for Equipment:
   a. Material and Thickness: Brass, 0.032-inch (0.77 mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
   b. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (65 by 20 mm).
   c. Minimum Letter Size: 1/4 inch (6 mm) for name of units. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
   d. Fasteners: Stainless steel rivets or self-tapping screws.
   e. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

2. Plastic Labels for Equipment:
   a. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.
   c. Background Color: Black or blue.
   d. Maximum Temperature: Able to withstand temperatures up to 160°F (71°C).
   e. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 x 3/4 inch (65 x 20 mm).
   f. Minimum Letter Size: 1/4 inch (6 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (15 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
   g. Fasteners: Stainless steel rivets or self-tapping screws.
   h. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

3. Label Content: Include equipment’s unique equipment number.

4. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2” x 11” (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the specification section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.
B. Pipe Labels:
1. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
2. Pretensioned Pipe Labels: Precoiled, semi-rigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
4. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
5. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
   a. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
   b. Lettering Size: At least 1-1/2 inches (40 mm) high.

C. Duct Labels:
1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, and having predrilled holes for attachment hardware.
2. Letter Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160°F (71°C).
5. Minimum Label Size: Length and width vary for required label content, but not less than 4 x 12 inch (100 x 300 mm).
6. Minimum Letter Size: 2 inch (50 mm). Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
9. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.
   a. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
   b. Arrow Size: At least 6 inches (150 mm) high.

D. Stencils:
1. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 2 inches (50 mm) for ducts; and minimum letter height of 3/4 inch (20 mm) for access panel and door labels, equipment labels, and similar operational instructions.
2. Stencil Material: Fiberboard or metal.
3. Stencil Paint: Exterior, gloss enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
4. Identification Paint: Exterior enamel in colors according to ASME A13.1 unless otherwise indicated.

E. Valve Tags:
1. Valve Tags: Stamped or engraved with 1/4-inch (6 mm) letters for piping system abbreviation and 1/2-inch (15 mm) numbers.
   a. Tag Material: Brass, 0.032-inch (0.77 mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
   b. Fasteners: Brass wire-link or beaded chain; or S-hook.
2. Valve Schedules: For each piping system, on 8-1/2" x 11" (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
   a. Valve-tag schedule shall be included in operation and maintenance data.
PART 3 – EXECUTION

3.01 HVAC DEMOLITION

A. Refer to Division 1 and Division 2 for general demolition requirements and procedures.

B. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.
   1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
   2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
   3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
   4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
   5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to the Owner.

C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.02 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 23 Sections specifying HVAC piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
   1. New Piping:
      a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
      b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
c. Insulated Piping: Split, cast-brass type with spring clips.
d. Bare Piping at Wall, Floor, and Ceiling Penetrations in Finished Spaces, Unfinished Service Spaces, and Equipment Rooms: One-piece or split, cast-brass type with polished chrome-plated finish.

2. Existing Piping: Use the following:
   a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
   b. Insulated Piping: Split, cast-brass type with spring clips.
   c. Bare Piping at Wall, Floor, and Ceiling Penetrations in Finished Spaces, Unfinished Service Spaces, and Equipment Rooms: Split, cast-brass type with polished chrome-plated finish.

M. Sleeves are not required for core-drilled holes.

N. Install sleeves for pipes passing through concrete and masonry walls, gypsum board partitions, and concrete floor and roof slabs.
   1. Cut sleeves to length for mounting flush with both surfaces.  
      Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
   2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
   3. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
      a. Steel Pipe Sleeves: For pipes smaller than NPS 6 (DN 150).
   4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 7 for materials and installation.

O. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials listed for application. Refer to Division 7 for firestopping materials.

P. Verify final equipment locations for roughing-in.

Q. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

R. Install dielectric fittings or approved adaptor fittings on all joints between different piping materials on steam, hot water, chilled water, condenser water, steam condensate, ground source heat pump loop systems and other hydronic mechanical piping systems.

S. Old Pipe Lines: If any old sewer, water, gas, or other pipes are encountered that interfere with the proper installation of new work and that will not be used in connections with the new work, close all openings in proper manner or, if necessary, relocate or remove the pipes as shown on plans. Should any old pipes and/or electrical lines not shown on plans be encountered, immediately notify Owner's representative before taking any action.

3.03 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.


F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
   1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.
   2. CPVC Piping: Join according to ASTM D2846 (D2846M) Appendix.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D3139.

3.04 ACCESS PANELS

A. Furnish access panels where required for access to concealed HVAC items such as dampers, valves, strainers, shock absorbers, cleanouts, control devices, and where required for equipment servicing.

B. Deliver all panels to General Contractor for installation. Provide instructions for their location in sufficient time so panels can be installed in the normal course of work.

3.05 IDENTIFICATION COMMON REQUIREMENTS

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.


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. Pumps:
   a. Identify as to service and zones served.
   b. Install nameplate or stencil system served on base mounted pumps.
   c. Install brass tags secured by tie wires on small in-line pumps.

6. Storage Tanks, Water Treatment Equipment and Heaters:
   a. Stencil service on tanks and heaters
   b. Label connecting pipes and indicate the service temperature entering and leaving the tank or heater.

7. Air Conditioning Equipment:
   a. Equipment such as chillers, pumps, condensers, or rooftop equipment: Identified by stencils, or system nameplates. Labels of remote equipment shall also indicate the space(s) being served and the location of their electrical breaker (Panel ID, Room No. And Circuit).
   b. Identify locations of air handling devices which have filters and are above accessible ceilings by a blue circular dot or tack at least 3/4 inch in diameter, or embossed tape, adhered to the nearest T-bar.
8. **Access Doors:**
   a. Provide engraved nameplates or painted stencils to identify concealed valves, controls, dampers or other similar concealed mechanical equipment.
   b. Identify the locations of fire dampers above accessible ceilings with a red circular dot at least 3/4 inch in diameter, or embossed tape, adhered to the nearest T-bar. Access door shall be painted red.
   c. Obtain the university Project Manager’s approval before installation on all access doors in finished areas.

9. **Lift-Out Ceilings:**
   a. Provide engraved nameplates on ceiling tee stem (screwed or riveted, adhesive not allowed) to identify concealed valves, VAV boxes, filters, fire/smoke dampers or similar concealed mechanical equipment that is directly above nameplate in ceiling space.
   b. Obtain the University Project Manager’s approval of tag locations before installation.

10. **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.

### D. Piping Label Tags

<table>
<thead>
<tr>
<th>Classification</th>
<th>Color of Field</th>
<th>Letter Colors</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Materials Inherently Hazardous:</td>
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<td>Flammable or Explosive:</td>
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<td>AW</td>
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<td>Extreme Temperatures or Pressures:</td>
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<td>Dom HW</td>
</tr>
<tr>
<td>Domestic Hot Water, Circulating</td>
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<td>Dom HWC</td>
</tr>
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<td>HWS</td>
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<td>LPS</td>
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<tr>
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<td>LPSC</td>
</tr>
<tr>
<td>High Pressure Steam</td>
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<td>HPS</td>
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<td>High Pressure Steam Condensate</td>
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<td>HPSC</td>
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<td>Refrigerant</td>
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<td>High Pressure Compressed Air (over 90 psig)</td>
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<td>Condenser Water Return</td>
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<td></td>
</tr>
</tbody>
</table>

**COMMON WORK RESULTS FOR HVAC**

23 05 00 - 13
### Classification Color of Field Letter Colors Code

<table>
<thead>
<tr>
<th>Classification</th>
<th>Color of Field</th>
<th>Letter Colors</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas or Gaseous Admixture:</td>
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<tr>
<td>Medium Pressure Compressed Air (30 to 90 psig)</td>
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<td>White</td>
<td>CA</td>
</tr>
<tr>
<td>Low Pressure Compressed Air (less than 30 psig)</td>
<td>Blue</td>
<td>White</td>
<td>CA</td>
</tr>
<tr>
<td>Vacuum</td>
<td>White</td>
<td>Black</td>
<td>VAC</td>
</tr>
<tr>
<td>Fire Quenching Materials:</td>
<td>Red</td>
<td>White</td>
<td>FL</td>
</tr>
</tbody>
</table>

**E. Mechanical Equipment Naming Strategy:**
1. Equipment identification numbers may be up to 32 characters. Equipment naming strategy is:
   - System – Bld – Number
     - ####-####-###-###
2. The first three placeholders are reserved for the system designation (alpha characters)
3. The fourth character is a hyphen.
4. The fifth through ninth placeholders are reserved for the building designation (alpha and/or numeric)
5. The tenth character is a hyphen
6. 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.
7. The seventeenth character is a hyphen
8. In some instances the point name will be followed by a hyphen and a sub-point name
9. All device and point names will be assigned by the Facilities Operations, Building Operations Department.
10. All references to equipment and devices in drawings, labels, equipment tags, BAS system, etc., must use this naming convention.
11. Equipment designation, for prints may exclude the building designator.

#### 3.06 PAINTING

A. Painting of HVAC systems, equipment, and components is specified in Division 9 for interior painting and exterior painting.

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

#### 3.07 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 5 for structural steel

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor fire-suppression materials and equipment.

C. Field Welding: Comply with AWS D1.1.
3.08 CLEANING

A. Cleaning and Flushing:

1. All water circulating systems for the project shall be thoroughly cleaned before placing in operation to rid the system of dirt, piping compound, mill scale, oil, and any and all other material foreign to the water being circulated.

2. Extreme care shall be exercised during construction to prevent all dirt and other foreign matter from entering the pipe or other parts of the system. Pipe stored on the project shall have the open ends capped, and equipment shall have all openings fully protected. Before erection, each piece of pipe, fitting, or valve shall be visually examined and all dirt removed.
   a. Heating Water Systems: Hot water heating systems, including converters, pumps, coils, and piping shall be cleaned with a solution of trisodium phosphate. This cleaning also applies to glycol systems prior to filling. Apply heat while circulating, slowly raising system to design temperature; maintain for a minimum of 24 hours. Remove heat and allow to cool; drain, and refill with clean water. Circulate for 6 hours at design temperature, then drain. Refill with clean water and repeat until system cleaner is removed.

3. After the system (or portion thereof) has been leak tested, thoroughly flush with clean water. During the clean water flush, all valves shall be full open, the flow rate for flush shall be at least 4 ft./sec., and the total flow shall equal at least five times the total piping system volume. Flushing shall continue until water runs clear.

4. After clear water flushing is complete, a chemical flushing solution, shall be utilized to remove oil, grease, piping compounds, etc. After the system is filled with this solution, the system shall be brought up to temperature and allowed to circulate for at least eight hours. The system shall then be drained completely and refilled with fresh water.

5. After the system has been completely cleaned as specified herein, it shall be tested by litmus paper or other dependable method and shall be left on the slightly alkaline side (pH = 7.5+). If the system is found to be still on the acid side, the chemical flush shall be repeated as necessary.

6. The Owner's representative shall be given notice of this cleaning operation. If the Owner's representative deems it necessary, the cleaning operation shall be repeated.

7. "Stop-Leak" compounds shall not be added to the system at any time.

8. Immediately after clear water flushing is complete, a chemical corrosion inhibitor solution, as furnished by the Division 23 Section "Water Treatment," Vendor/Contractor, shall be utilized to initially treat the system.

9. Clean exterior of piping prior to application of coatings.

B. Cleanup:

1. Clean coils and plenums.
2. Clean under, in and around equipment.
3. Clean exposed surfaces of ducts, piping, and equipment.
4. Clean equipment cabinets and enclosures.
5. Provide all new filters for equipment.

END OF SECTION
SECTION 230523

GENERAL DUTY VALVES FOR HVAC

PART 1 – GENERAL

1.01 SUMMARY

A. This Section includes the following general-duty valves:
   1. Bronze ball valves
   2. Eccentric balancing valves

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specifications, apply to this Section.

1.03 DEFINITIONS

A. The following are standard abbreviations for valves:
   1. CWP: Cold working pressure
   2. EPDM: Ethylene-propylene-diene terpolymer rubber
   3. PTFE: Polytetrafluoroethylene plastic
   4. SWP: Steam working pressure
   5. TFE: Tetrafluoroethylene plastic

1.04 SUBMITTALS

A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

1.05 QUALITY ASSURANCE

A. ASME Compliance: ASME B31.9 for valves up to 125 psig and ASME B31.1 valves above 125 psig.

B. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.

C. NSF Compliance: NSF 61 for valve materials for potable-water service.

D. Source Limitations: Obtain valves of a single type through one source from a single manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
   1. Protect internal parts against rust and corrosion.
   2. Protect threads, flange faces, grooves, and weld ends.
   3. Set ball and plug valves open to minimize exposure of functional surfaces.

B. Use the following precautions during storage:
   1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
   1. Subject to compliance with requirements, provide products by the manufacturers specified.

2.02 VALVES, GENERAL

A. Refer to Part 3 "Valve Applications" Article for applications of valves.

B. Bronze Valves: NPS 2 and smaller with threaded ends, unless otherwise indicated.

C. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

D. Valve Sizes: Same as upstream pipe, unless otherwise indicated.

E. Valve Actuators:
   1. Lever Handle: For quarter-turn valves NPS 6 and smaller, except plug valves.

F. Extended Valve Stems: On insulated valves.

G. Valve Ends:
      a. Caution: Use solder with melting point below 840°F for angle, check, gate, and globe valves; below 421°F for ball valves.
      b. Threaded: With threads according to ASME B1.20.1.

H. Valve Bypass and Drain Connections: MSSSP-45

2.03 BALL VALVES

A. Bronze Two-Piece Ball Valves:
   1. Manufacturer and Model:
      a. Threaded Ends:
         1) Apollo 77-100 Series
         2) Equivalent by Crane, Jamesbury or Jenkins
      b. Soldered Ends:
         1) Apollo 77-200 Series
         2) Equivalent by Crane, Jamesbury or Jenkins
   2. 150 psig SWP, non-shock 600 psig WOG, MSS SP-110, cast bronze, full port, two-piece body design, chrome-plated solid bronze ball with reinforced Teflon seats. Stem packing adjustable for wear with adjusting screw.
2.04  ECCENTRIC PLUG VALVES

A. Balancing Service:
1. Threaded, class 125
   a. Milliken Millcentric, Figure 613A
   b. Equivalent by Dezurik
2. Flanged, class 125:
   a. Milliken Millcentric, Figure 611
   b. Equivalent by Dezurik
3. Ductile iron, permanently lubricated plug-type or multi-turn hand wheel with suitable seals for intended service, lever or multi-turn operator for valves through 6 inches, adjustable memory stops all sizes.

2.05  SWING CHECK VALVES

A. Bronze, 150 psig SWP, 300 psig non-shock WOG, MSS SP-80, class 150, renewable bronze disc.
1. Manufacturer and Model:
   a. Threaded:
      1) Milwaukee 510-T
      2) Stockham B-321
      3) Equivalent by Crane
   b. Soldered:
      1) Milwaukee 1510-T
      2) Stockham B-321
      3) Equivalent by Crane

B. Flanged, iron body, 125 psig SWP, 200 psig non-shock WOG, MSS SP-71, Class 125, bronze trim.
1. Manufacturer and Model:
   a. Milwaukee F2974
   b. Stockham G-931
   c. Equivalent by Crane

PART 3  - EXECUTION

3.01  EXAMINATION

A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

D. Examine threads on valve and mating pipe for form and cleanliness.

E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

F. Do not attempt to repair defective valves; replace with new valves.
3.02 VALVE APPLICATIONS

A. Refer to piping Sections for specific valve applications. If valve applications are not indicated, use the following:
   1. Shutoff Service:
      a. Water and Glycol:
         1) NPS 2 and Smaller: Ball valves.
   2. Throttling Service:
      a. NPS 2 and Smaller: bronze: Class 150, threaded.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.

C. Heating Water Piping: Use the following types of valves:
   1. Ball Valves, NPS 2 and Smaller: Bronze two-piece, threaded or soldered.
   2. Balancing Valves:
      a. NPS 2 and Smaller: Threaded, Class 125.

3.03 VALVE INSTALLATION

A. Piping installation requirements are specified in other Division 2315 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. All equipment and materials shall be installed in accordance with the recommendations of the manufacturer.

C. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

D. Locate valves for easy access and provide separate support where necessary.

E. Install valves in horizontal piping with stem at or above center of pipe.

F. All valves shall be installed so they are accessible and serviceable. Install valves in position to allow full stem movement.

G. All valves shall be installed so the stem position is not more than 90-degrees from the vertical up position.

H. Isolation valves shall be installed:
   1. In piping at each and every piece of equipment
   2. In piping whenever said pipe enters or leaves an equipment room
   3. At all branch take-offs from mains
   4. Where shown on drawings

I. Valve identification requirements are in other Division 23 sections.

3.04 JOINT CONSTRUCTION

A. Refer to Division 23 Section "Common Work Results for HVAC" for basic piping joint construction.

B. Grooved Joints: Assemble joints with keyed coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.
C. Soldered Joints: Use ASTM B813, water-flushable, lead-free flux; ASTM B32, lead-free-alloy solder; and ASTM B828 procedure, unless otherwise indicated

3.05 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

END OF SECTION
PART 1 - GENERAL

1.01 SUMMARY

A. This section includes the following insulation for HVAC systems:
   1. Insulation materials
   2. Fire-rated insulation systems
   3. Mastics and adhesives
   4. Jacketing

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specifications, apply to this Section.

1.03 DEFINITIONS

A. The word "concealed" as used in this section refers to insulation in ceiling plenums, furred spaces, pipe and duct shafts, unheated spaces immediately below roof and crawl spaces. The word "exposed" refers to insulation in other areas.

1.04 SYSTEM DESCRIPTION

A. Systems to be Insulated: Insulate portions of the following systems, equipment, and accessories, except where noted otherwise or furnished by OEM as part of equipment.
   1. Hot Piping Systems:
      a. HVAC heating water piping
      b. Fittings, valves, strainers, and check valves
   2. Ductwork and Breeching:
      a. Concealed HVAC supply, transfer, and return ductwork except as noted
   3. Items that need not be insulated:
      a. Piping within baseboard (fin tube) radiation enclosures

1.05 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

B. Shop Drawings:
   1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
   2. Detail attachment and covering of heat tracing inside insulation.
   3. Detail insulation application at pipe expansion joints for each type of insulation.
   4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
   5. Detail removable insulation at piping specialties, equipment connections, and access panels.
   6. Detail application of field-applied jackets.
   7. Detail application at linkages of control devices.
   8. Detail field application for each equipment type.
C. Field quality-control reports.

1.06 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Storage and Protection: Protect insulation against dirt, water, chemical, or mechanical damage before, during, and after installation. Satisfactorily repair or replace any such insulation or covering damaged prior to final acceptance of the work.

B. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.08 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.09 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.01 PIPE INSULATION

A. Manufacturers:
   1. Certainteed Crimpwrap
   2. Knauf Insulation; 1000 Pipe Insulation
   3. Rubatex
   4. Owens Corning; Fiberglas Pipe Insulation
   5. Johns Manville; Micro-Lok
B. Preformed fiberglass conforming to ASHRAE 90.1-2004, ASTM C547, Class I or II, and ASTM C585 with "K" factor of 0.23 Btu-in./h-sf-°F maximum at 75°F mean temperature. See schedule for thickness.

C. Provide factory-applied ASJ/SSL type, ASTM C921, or ASTM C1136, Type I jacket with vapor barrier for cold piping (below ambient), or Type II for hot piping (above ambient). Type I may be used for both at Contractor’s option. Factory-applied flap adhesive (SSL) or conventional staple and tape seal at Contractor’s option.

D. Pipe Insulation Thickness Schedule:

<table>
<thead>
<tr>
<th>Piping System Type</th>
<th>Minimum Insulation Thickness for Pipe Sizes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>From: NPS 1</td>
</tr>
<tr>
<td></td>
<td>To less than: NPS 1</td>
</tr>
<tr>
<td>1. Heating hot water supply and return up to 200°F</td>
<td>1-1/2”</td>
</tr>
</tbody>
</table>

Note: For piping exposed to outdoor ambient temperatures, increase thickness by 0.5 in.

E. Cover fittings and valves with premolded one-piece PVC-insulated covers. This product is not to be installed in locations where its use is prohibited by local codes.

F. Protect insulation on exterior piping exposed to the weather with weatherproof metal jacket. Provide jacket with 0.016-inch-thick aluminum, with laminated vapor barrier. Provide “Z” groove in jacket to assure watertight seal. Seal each joint with snap straps containing permanently plastic sealing compound and secured by 1/2-inch-wide stainless steel bands.

2.02 DUCT INSULATION

A. Specification “A”: 1-1/2-inch-thick fiberglass 3/4 lbs/ft³ density blanket with factory-applied heavy duty FSK facing with a "K" value of 0.28 Btu-in./h-sf-°F maximum at 75°F mean temperature.

B. Specification “B”: 1-1/2-inch-thick, 3.0 lbs/ft³ density fiberglass insulation board. Provide preformed, flat, rectangular, rigid insulation with "K" value of 0.22 Btu-in./h-sf-°F maximum at 75°F mean temperature.

C. Specification “C”: 2-inch-thick, 3.0 lbs/ft³ density fiberglass insulation board equal to CSG Group with factory-applied FSK vapor barrier facing. Provide preformed, flat, rectangular, rigid insulation with a "K" value of 0.22 Btu-in./h-sf-°F maximum at 75°F mean temperature.

D. Specification “L” and “R”: See Duct Liner specification below for materials and required liner thickness.

E. Duct Insulation and Lining Schedule:

<table>
<thead>
<tr>
<th>System</th>
<th>Insulation Spec</th>
<th>Thickness</th>
<th>Vapor Seal Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. HVAC supply - concealed</td>
<td>A</td>
<td>1.5”</td>
<td>Yes</td>
</tr>
<tr>
<td>2. HVAC return - concealed</td>
<td>A</td>
<td>1.5”</td>
<td>No</td>
</tr>
</tbody>
</table>
Construction Documents
UNIVERSITY OF COLORADO DENVER - ANSCHUTZ MEDICAL CAMPUS
UCD Building 500 - 6th Floor Cancer Renovation
UCD Project No. 17-289575

HVAC – MECHANICAL INSULATION
23 07 00 - 4

2.03 DUCT LINER

A. General:
1. Comply with requirements of NFPA 90A and 90B, UL 181 Class 1, ASTM C1071, and the Materials Standard of the North American Insulation Manufacturer’s Association (NAIMA); Type 200, Flame Spread 25 maximum and Smoke Development 50 maximum.
2. Absorption: Not more than 1% moisture when tested per ASTM C553.
3. Corrosion: Shall not cause corrosion of duct material (aluminum or galvanized steel) when tested per ASTM C665.
5. Coating: Coat air-stream surface and transverse edge with a factory-coated tough composite material to provide a maximum average velocity rating of 5,000 fpm or better at 250°F when tested per ASTM C1071.
6. Thermal Resistance: "K" value of 0.27 Btu-in./h-sf.-°F for less (1-inch thickness, 1 lb/ft³) when tested per ASTM C518 at 75°F mean temperature.
7. Sound Absorption: Sound absorption coefficient (1-inch thickness, 1 lb/ft³) of 0.72 or higher at 1,000 Hz when tested per ASTM C423, Type A mounting. Round duct liner shall have a Noise Reduction Coefficient (NRC) of 0.70 or better when tested per ASTM C423, Type A mounting.

B. Rectangular Liner, Specification "L": Approved manufacturers are CertainTeed (ToughGard), Knauf type E-M, Owens-Corning (Aeroflex), and Johns-Manville (Permacote Linacoustic).
1. Duct sizes shown on drawings are clear internal dimensions and do not include liner.

C. Round Liner, Specification "R":
1. Approved Manufacturers: Johns-Manville (Spiracoustic Plus).
2. Round Duct Liner:
   a. Use "Spiracoustic Plus" slip-in or snap-in fiberglass duct board with airstream surface Permacote coating or Engineer-approved equal.
   b. Install liner in both straight duct and fittings per manufacturer’s recommendations. Fill and seal all gaps and tears or abrasions per manufacturer's recommendations. Coat edges exposed to the air-stream with Superseal HV sealant or Engineer-approved equal.
   c. Duct sizes shown on drawings are clear INTERNAL dimensions, increase shell diameter accordingly.

*UL YYET listing not required on type II duct. Approval from Authority Having Jurisdiction must be obtained prior to application of specification “E” fireproofing wrap.
**Other than kitchen exhausts.
2.04 ADHESIVES

A. Provide materials compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
   1. Products: Subject to compliance with requirements, provide one of the following:
      b. Eagle Bridges - Marathon Industries; 225.
      d. Mon-Eco Industries, Inc.; 22-25.
   2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. PVC Jacket Adhesive: Compatible with PVC jacket.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Dow Corning Corporation; 739, Dow Silicone.
      d. Speedline Corporation; Polyco VP Adhesive.
   2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.05 MASTICS

A. Provide materials compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
   1. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.
   1. Products: Subject to compliance with requirements, provide one of the following:
      b. Vimasco Corporation; 749.
   2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
   3. Service Temperature Range: Minus 20 to plus 180 deg F.
   4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.

C. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.
   1. Products: Subject to compliance with requirements, provide one of the following:
      b. Eagle Bridges - Marathon Industries; 570.
   2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
   3. Service Temperature Range: Minus 50 to plus 220 deg F.
   4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
D. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
   1. Products: Subject to compliance with requirements, provide one of the following:
      b. Eagle Bridges - Marathon Industries; 550.
      e. Vimasco Corporation; WC-1/WC-5.
   2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
   3. Service Temperature Range: Minus 20 to plus 180 deg F.
   4. Solids Content: 60 percent by volume and 66 percent by weight.

2.06 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:
   1. Products: Subject to compliance with requirements, provide one of the following:
      b. Eagle Bridges - Marathon Industries; 405.
      c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
      d. Mon-Eco Industries, Inc.; 44-05.
   2. Materials shall be compatible with insulation materials, jackets, and substrates.
   3. Fire- and water-resistant, flexible, elastomeric sealant.
   4. Service Temperature Range: Minus 40 to plus 250 deg F.
   5. Color: Aluminum.
   6. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:
   1. Products: Subject to compliance with requirements, provide one of the following:
   2. Materials shall be compatible with insulation materials, jackets, and substrates.
   3. Fire- and water-resistant, flexible, elastomeric sealant.
   4. Service Temperature Range: Minus 40 to plus 250 deg F.
   6. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.01 INSTALLERS

A. Install insulation with workmen regularly engaged in this kind of work in strict accordance with the manufacturer's recommendations and recognized industry practices.

3.02 INSTALLATION

A. General:
   1. Apply full-length units of insulation on clean, dry surfaces free of foreign matter. Apply only after tests and approvals required by the specifications have been completed.
2. Apply insulation on cold surfaces with a continuous, unbroken vapor seal. Provide insulation and vapor seal at supports, anchors, etc., that are secured directly to cold surfaces to prevent condensation.

3. Finish raw edges with finishing cement.

B. Pipe Insulation:
1. Insulate pipe continuously through walls and floor openings except where walls and floors are required to be fire-stopped or required to have a fire-resistance rating. Where this occurs, fill the open space remaining between the sleeve and pipe with fire-stop.

2. Butt joints firmly together and smoothly, secure self-sealing jacket laps and joint strips with monel staples at 6-inch o.c. and cover with lap adhesive or factory (SSL) adhesive.

3. Seal ends of cold pipe insulation with a vapor barrier coating at fittings and valves and at intervals of 21 feet on continuous runs of pipe.

4. Insulate cold pipes continuously through hangers. Provide rigid insulation inserts at pipe hangers and supports per Division 23 Section "Hangers and Supports for HVAC Mechanical Systems." Abut pipe insulation to the rigid insulation insert. Apply a wet coat of vapor barrier lap cement on butt joints and seal the joints with 3-inch-wide vapor barrier tape or band. Coat staples with heavy coat of brushed on vapor barrier lap cement.

5. Insulate sections of piping where new control valves are to be installed.

C. Insulation on Fittings and Valves:
1. Where the factory premolded one-piece PVC insulated fitting covers are to be used, apply the proper factory precut insulation to the fitting using two layers for pipe temperatures above 250°F or below 35°F, single layer insulation is suitable between 35°F and 250°F. Tuck the ends of the insulation snugly into the throat of the fitting with the edges adjacent to the pipe covering, tufted and tuckd in, fully insulating the pipe fitting. Overlay the covers to adjoining pipe insulation and jackets and seal all cold pipes at seam edges with vapor barrier adhesive. Seal the circumferential edges of covers with pressure sensitive tape. Overlay the tape on the jacket and the cover at least 1 inch.

2. At locations where the PVC covers are prohibited, use as an alternate one of the following methods: one-coat insulation cement, premolded fiberglass fitting covers, or mitered segments of pipe insulation. Provide glass fabric embedded in fire-retardant mastic finish. Use vapor barrier mastic for cold piping.

3. Insulate valves with sections of fiberglass pipe insulation complete with all service jackets. Coat raw ends with vinyl acrylic mastic for hot piping or vapor barrier mastic for cold piping.

D. Duct Liner:
1. For velocities up to 2000 fpm, apply duct liner with 100% coverage of fire-retardant adhesive. Cut duct liner to assure snug corner joints. Face the coated or most dense surface of the liner to the airstream. Additionally secure the duct liner with mechanical fasteners that compress the duct liner sufficiently to hold it firmly in place. Start the fasteners within 3 inches of the leading edge of each duct section (and line transverse joints within the duct section) and space no more than 12-inch o.c. around the perimeter of the duct, except that they need to be no closer than 9 inches to a corner break. Elsewhere, secure at a maximum of 18-inch o.c., except place not more than 6 inches from a cut edge, nor 12 inches from a corner break. Coat exposed edges and the leading edge of cross joints of the liner with the same adhesive used to secure the duct liner to the metal surface.

2. Install round duct liner per manufacturer's recommendations:
   a. Install slip-in type (24-inch I.D. or less) in straight duct sections without use of pins or mastic. Insulate fittings with cut sections installed using mastic and/or pins per manufacturer's instructions.
   b. Pin snap-in type (24-inch I.D.) in straight duct sections and pin with mastic in fittings per manufacturer's instructions.
3. Install liner in both straight duct and fittings per manufacturer's recommendations. Fill gaps and tears or abrasions per manufacturer's recommendations. Coat edges exposed to the airstream with Superseal HV sealant or Engineer-approved equal.

E. Other Requirements:
   1. Do not insulate boiler manholes, handholes, cleanouts, ASME stamp, and manufacturer's nameplate. Provide neatly beveled edge at interruptions of insulation.
   2. Provide removable insulation sections to cover parts of equipment that must be opened periodically for maintenance; include metal vessel covers, fasteners, flanges, frames, and accessories.
   3. Repair damaged sections of existing mechanical insulation, both previously damaged and/or damaged during this construction period. Use insulation of same thickness as existing insulation; install new jacket lapping and seal over existing.
   4. Replace damaged insulation that cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.

END OF SECTION
PART 1 - GENERAL

1.01 SUMMARY

A. This section covers the general requirements for the Division 23 responsibilities and performance in the startup, testing, and commissioning process.

1. Mechanical system installation, startup, testing, balancing, commissioning , preparation of O&M manuals, and operator training are the responsibility of the Contractor with coordination, observation, verification the responsibility of Division 1. The Division 1 Commissioning process does not relieve Division 23 from the obligations to complete all portions of the work in a satisfactory and fully operational manner.

2. Work of Division 23 includes:

a. Testing and startup of the equipment.

b. Testing, adjusting, and balancing of hydronic and air systems.

c. Cooperation with the Commissioning Agent.

d. Providing qualified personnel for performance of start-up, testing, and commissioning tests.

e. Providing equipment, materials, and labor as necessary to correct construction and/or equipment deficiencies found during the start-up, testing, and commissioning process.

f. Providing operation and maintenance manuals and as-built drawings to the Commissioning Agent for verification.

g. Providing assistance to the Commissioning Agent to develop and edit system operating and maintenance procedure narratives.

h. Providing training and demonstrations for the systems specified in this Division.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specifications, apply to this Section.

1.03 TRAINING

A. In addition to the requirements of Division 1, coordinate participation in the training of the Owner’s engineering and maintenance staff on each system and related components with the Commissioning Agent. Training will be conducted in a classroom setting, with field demonstrations as appropriate, with system and component documentation and suitable classroom training aids.

PART 2 - PRODUCTS

2.01 TEST EQUIPMENT

A. Provide test equipment as necessary for testing and startup o the mechanical equipment and systems.

2.02 TEST EQUIPMENT - PROPRIETARY
A. Proprietary test equipment, hardware, and software required by the equipment manufacturer for programming and/or startup, whether specified or not, shall be provided to the Commissioning Agent at no cost. Provide the test equipment, demonstrate its use, and assist the Commissioning Agent in the startup, testing, and commissioning process. Proprietary test equipment (and software) shall become the property of the Owner upon completion of the start-up, testing, and commissioning process.

B. Controls contractor/manufacturer shall provide a printout of:
   1. All software code
   2. All user interface screens

PART 3 - EXECUTION

3.01 WORK PRIOR TO FUNCTIONAL TESTING

A. Complete all phases of work so the systems can be started, tested, balanced, and commissioned. Contractor has primary startup responsibilities for all mechanical systems so they are functional. This includes the complete installation of all equipment, materials, pipe, duct, wire, insulation, controls, etc.

B. A commissioning plan will be developed by the Commissioning Agency. Division 23 is obligated to assist the Commissioning Agency in preparing the Commissioning plan by providing all necessary information pertaining to the actual equipment and installation. If Contractor-initiated system changes have been made that may alter the Commissioning process, the Contractor shall notify the Commissioning Agent and Owner’s representative.

C. Specific pre-commissioning responsibilities of Contractor are as follows:
   1. Factory startup services for the following items of equipment:
      a. Control systems
   2. Normal startup services required to bring each system into a fully operational state. Provide skilled technicians to start up and debug all systems within Division 23. This includes motor rotational check, belt and alignment checks, cleaning, filling, purging, leak testing, testing control sequences of operation, full-load and part-load performance, etc. The Commissioning Agency will not begin the testing and verification process until each system is complete, including normal Contractor startup.

D. Functional testing is normally intended to begin prior to completion of a system and/or subsystems and will be coordinated with the Division 23 Contractor. Start of Commissioning before system completion does not relieve the Contractor from completing those systems as per the schedule.

E. Complete and sign functional performance test forms. Contractor is responsible for assuring the items checked off as complete are ready for Commissioning Agency verification.

3.02 PERFORMANCE OF COMMISSIONING

A. It is the responsibility of the Contractor to perform commissioning testing and demonstration. It is the responsibility of the Commissioning Agent only to coordinate, schedule, observe and verify, and report.

B. The same technicians that performed start-up and testing shall be made available to assist the Commissioning Agency in completing the Commissioning program. Work schedules, time required for testing, etc., will be requested by the Commissioning Agent and coordinated by the Contractor. Contractor will ensure that the qualified technician(s) are available and present during the agreed-upon schedules and of sufficient duration to complete the necessary tests, adjustments, and/or problem resolutions.
C. System performance problems and discrepancies may require additional technician time, Commissioning Agent time, reconstruction of systems, and/or replacement of system components. The additional technician time shall be made available for subsequent Commissioning periods until the required system performance is obtained.

D. The Commissioning Agency reserves the right to question the appropriateness and qualifications of the technicians relative to each item of equipment, system, and/or subsystem. Qualifications of technicians will include expert knowledge relative to the specific equipment involved and a willingness to work with the Commissioning Agency to get the job done. Contractor shall also provide adequate documentation and tools as necessary to start up and test the equipment, system, and/or subsystem.

3.03 WORK TO RESOLVE DEFICIENCIES

A. In some systems misapplied equipment, and/or deficient performance under varying loads will result in additional work being required to start-up, test and commission the systems. This work will be completed under the direction of the Owner’s representative with input from the Commissioning Agency. Whereas all members will have input and the opportunity to discuss, debate, and work out problems, the Owner will have final jurisdiction over any additional work done to achieve performance.

B. Division 23 corrective work must be completed in a timely fashion to permit the timely completion of the start-up, testing, and commissioning process. Experimentation to demonstrate system performance may be permitted. If the Commissioning Agent deems the experimentation work to be ineffective or untimely as it relates to the commissioning process, the Commissioning Agent will notify the Owner’s representative, indicating the nature of the problem, expected steps to be taken, and suggested deadline(s) for completion of activities.

3.04 ADDITIONAL COMMISSIONING

A. Additional Commissioning activities may be required after system adjustments, replacements, etc., are completed. The Contractor shall complete this work as part of the Contractor’s basic contractual obligations.

3.05 SEASONAL COMMISSIONING

A. Seasonal commissioning pertains to testing under full-load conditions during peak heating and cooling seasons, as well as part-load conditions in the spring and fall. Initial commissioning will be done as soon as contract work is completed, regardless of season. Subsequent commissioning shall be undertaken at appropriate times thereafter to ascertain adequate performance during the different seasons.

B. Cooling equipment shall be tested as close to summer design extremes as possible (subject to Owner schedule limitations) with a fully occupied building. Contractor will be responsible to perform the initial and the alternate peak season tests of the systems as required to demonstrate performance.

C. Training will be hosted by the Commissioning Agent and conducted by the Contractor(s) and vendors. The Contractor will be responsible for highlighting system peculiarities specific to this project.

END OF SECTION
SECTION 233100

HVAC – DUCTS AND ACCESSORIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specifications, apply to this Section.

1.02 SUMMARY

A. Section Includes: This section covers general requirements for ducts and accessories including:
   1. Sheet metal materials
   2. Single-wall rectangular ducts and fittings
   3. Single-wall round ducts and fittings
   4. Sealant and gaskets
   5. Hangers and supports
   6. Manual volume dampers
   7. Life safety dampers
   8. Duct mounted access doors
   9. Duct access panel assemblies
   10. Flexible connectors
   11. Flexible ducts
   12. Sound boots

1.03 SUBMITTALS

A. Product Data:
   1. Flexible duct and take-off fittings
   2. Duct sealant and fire-stop materials
   3. Duct access doors
   4. Fire, smoke, and combination fire/smoke dampers:
      a. Submit AMCA-certified pressure drop data.
      b. Document conformance to NFPA 90A and UL555, 555S, or 555C.
   5. Backdraft and relief dampers

B. Shop Drawings:
   1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
   2. Factory- and shop-fabricated ducts and fittings.
   3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
   4. Elevation of top of ducts.
   5. Dimensions of main duct runs from building grid lines.
   6. Fittings.
   7. Reinforcement and spacing.
   8. Seam and joint construction.
   9. Penetrations through fire-rated and other partitions.
   10. Equipment installation based on equipment being used on Project.
   11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
   12. Hangers and supports, including methods for duct and building attachment.
C. Delegated-Design Submittal:
1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.
5. Design Calculations: Calculations for selecting hangers and supports.

D. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:
   a. Lighting fixtures.
   b. Air outlets and inlets.
   c. Speakers.
   d. Sprinklers.
   e. Access panels.
   f. Perimeter moldings.
7. Refer to Division 23 Section “Common Work Requirements for HVAC Work” for additional requirements.

E. Welding certificates.

F. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.

1.04 QUALITY ASSURANCE


B. Comply with AMCA 500-D testing for damper rating.

C. Welding Qualifications: Qualify procedures and personnel according to the following:


E. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2007, Section 6.4.4 - "HVAC System Construction and Insulation."

1.05 PERFORMANCE REQUIREMENTS

A. Contractor shall furnish and install ductwork and accessories, including offsets and size transitions, which may become evident during the course of construction, to avoid building construction and other considerations, to provide a complete and operational system.
B. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements specified design criteria.

C. Structural Performance: Duct hangers and supports shall withstand the effects of gravity, loads and stresses within limits and under conditions described in the 2006 International Building Code.

D. Air stream Surfaces: Surfaces in contact with the air stream shall comply with requirements in ASHRAE 62.1.

PART 2 - PRODUCTS

2.01 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653.
   2. Finishes for Surfaces Exposed to View or Weather: Mill phosphatized.

C. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.02 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. Rectangular Ducts: Fabricate ducts with indicated dimensions for the duct airway size. Allowance for liner thickness must be added to airway size to determine sheet metal size.

B. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "Rectangular Duct Construction" based on indicated static-pressure class unless otherwise indicated.
   1. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
   2. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible." Button punch lock, detail L-2, is not acceptable.
   3. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.03 SINGLE-WALL ROUND DUCTS AND FITTINGS

A. Round Ducts: Fabricate ducts with indicated dimensions for the inner duct airway size. Allowance for liner thickness must be added to airway size to determine sheet metal size.
B. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

1. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints" for static pressure class, applicable sealing requirements, materials involved, duct support intervals and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
   a. Transverse joints in ducts larger than 60 Inches in diameter shall be flanged.

2. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams" for static pressure class, applicable sealing requirements, materials involved, duct support intervals and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible." Snap lock seams, RL-6A, RL-6B, RL-7, and RL-8 and lap rivets, RL-3 and RL-4 are not acceptable.
   a. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.

3. Laterals and Tees Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals" and SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-6, "Conical Tees" for static pressure class, applicable sealing requirements, materials involved, duct support intervals and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.04 DUCT LINER

A. Refer to Division 23 Section "Mechanical Insulation."

2.05 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to ASTM E 84 certified by a nationally recognized testing laboratory.

B. Tape Sealing System:
   1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal, 2-inch.
   2. Manufacturer: Carlisle Hardcast DT-5300-Tape with RTA-50 coating or approved equal.
   5. Mold and mildew resistant.
   6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
   7. Service: Indoor and outdoor.
   8. Service Temperature: 0 to 200°F.
   9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
   10. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Water-Based Joint and Seam Sealant:
   1. Manufacturer: Carlisle Hardcast DS-321 coating or approved equal.
   5. Water resistant.
   6. Mold and mildew resistant.
   7. VOC: Maximum 75 g/L (less water).
8. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
10. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
11. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Flanged Joint Sealant: Comply with ASTM C 920.
   1. Description: Extruded butyl/EPDM proprietary copolymer sealant on a siliconized release paper.
   2. Manufacturer: Carlisle Hardcast GT-1902, or approved equal.
   3. Dimensions: 3/16 inch x 5/8 inch
   4. Resistant to mold, mildew and water:
   5. Service temperature: Minus 65 to plus 200°F
   6. VOC: 0 g/l.
   7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
   8. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

F. Round Duct Joint O-Ring Seals: Seal shall provide maximum leakage class of 3 cfm/100 sq ft at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
   1. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
   2. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.06 HANGERS AND SUPPORTS
A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
H. Trapeze and Riser Supports:
   3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

2.07 MANUAL VOLUME DAMPERS
A. Manufacturers:
   1. Greenheck
   2. Pottorff
   3. Ruskin

B. Rectangular, Steel, Low Velocity
   1. Manufacturer: Ruskin MD35, Greenheck MDB-15 or equal
   2. Type: Parallel blade or opposed blade with concealed or exposed linkage, all galvanized steel or all stainless steel
   3. Maximum Velocity: (1,500 fpm) or less
   4. Frame: 16-gauge, roll formed channel
   5. Blades: 16-gauge
   6. Maximum Blade Width: 8 inches, exception: single blade up to 12 inches.
   7. Blades 36 inches and longer and driven blade shall be furnished with reinforcing cone. Maximum blade length is 48 inches
   8. Shafts: 1/2-inch
   9. Bearings: Synthetic

C. Rectangular, Steel, Medium Velocity
   1. Manufacturer: Ruskin CD60 or equal
   2. Type: Parallel blade or opposed blade with concealed or exposed linkage, all galvanized steel or all stainless steel
   3. Maximum Velocity: (4000 fpm) or less
   4. Frame: 16-gauge, roll formed channel
   5. Blades: 16-gauge
   6. Maximum Blade Width: 8 inches, exception: single blade up to 12 inches
   7. Blades 36 inches and longer and driven blade shall be furnished with reinforcing cone. Maximum blade length is 48 inches
   8. Shafts: 1/2-inch
   9. Bearings: Synthetic

D. Round, Steel
   1. Manufacturer: Ruskin MDRS23, Greenheck MDB-15 or equal.
   2. Type: Single blade up to 20-inch diameter; use rectangular steel with round adapter above 20-inch diameter.
   3. Maximum Velocity: (2,000 fpm) or less.
   4. Frame: 20-gauge galvanized steel or stainless steel.
   5. Blades: 20-gauge galvanized steel or stainless steel.

E. Damper Actuators: Provide locking quadrant operators on all dampers unless otherwise noted on plans

2.08 LIFE SAFETY DAMPERS

A. Approved Manufacturers (Note: Not all manufacturers listed have products listed in all categories specified.):
   1. Greenheck
   2. Pottorff
   3. Ruskin

B. Fire Dampers:
   1. Type: Dynamic; rated and labeled according to UL 555 by a nationally recognized testing laboratory.
DUCTS AND ACCESSORIES

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11. High-temperature Release Devices: Each fire/smoke damper shall be furnished with a heat/fire release (trip) device as follows:  
   a. Dampers shall have electric manual reset type temperature actuator 165°F, Ruskin EFL 200 or approved equal.
12. Damper Position Indication: Each damper shall be equipped with an indication device that shall include (two) position indicator switches linked directly to the damper to remotely indicate damper full-open and full-closed blade positions.

2.09 DUCT-MOUNTED ACCESS DOORS

A. Manufacturers:
   1. American Warming and Ventilating; a division of Mestek, Inc.
   2. Cesco Products; a division of Mestek, Inc.
   3. Ductmate Industries, Inc.
   5. Greenheck Fan Corporation
   6. McGill AirFlow LLC
   7. Nailor Industries Inc.
   8. Pottorff; a division of PCI Industries, Inc.
   9. Ventfabs, Inc.

   1. Door:
      a. Double wall, rectangular.
      b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
      c. Vision panel.
      d. Hinges and Latches: 1" x 1" butt or piano hinge and cam latches.
      e. Fabricate doors airtight and suitable for duct pressure class.
   2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
      a. Number of Hinges and Locks:
      b. Access Doors Less Than 12 inches Square: No hinges and two sash locks.
      c. Access Doors up to 18 inches Square: Two hinges and two sash locks.
      d. Access Doors up to 24" x 48": Three hinges and two compression latches.
      e. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

<table>
<thead>
<tr>
<th>Size of Duct to be Accessed</th>
<th>Panel Size</th>
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</thead>
<tbody>
<tr>
<td>6 – 8-inch</td>
<td>4 x 8-inch</td>
</tr>
<tr>
<td>10 – 12-inch</td>
<td>8 x 12-inch</td>
</tr>
<tr>
<td>12 – 16-inch</td>
<td>10 x 16-inch</td>
</tr>
<tr>
<td>18-inch and over</td>
<td>16 x 24-inch</td>
</tr>
</tbody>
</table>

2.10 DUCT ACCESS PANEL ASSEMBLIES

A. Manufacturers
   1. Ductmate Industries, Inc.
   2. Flame Gard, Inc.
   3. 3M.
B. Labeled according to UL 1978 by an nationally recognized testing laboratory.

C. Panel and Frame: Minimum thickness 0.0528-inch carbon steel.

D. Fasteners: Carbon steel. Panel fasteners shall not penetrate duct wall.

E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.

F. Minimum Pressure Rating: 10-inch wg, positive or negative.

2.11 FLEXIBLE CONNECTORS

A. Manufacturers
   1. Ductmate Industries, Inc.
   2. Duro Dyne Inc.
   3. Ventfabrics, Inc.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to 2 strips of 2-3/4-inch-wide, 0.028-inch-thick, galvanized sheet steel or 0.032-inch-thick aluminum sheets. Provide metal compatible with connected ducts.

   1. Minimum Weight: 26 oz./sq. yd.
   2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
   3. Service Temperature: Minus 40 to plus 200 deg F.

2.12 FLEXIBLE DUCTS

A. Manufacturers:
   1. Flexmaster U.S.A., Inc.
   2. Thermaflex
   3. Hercules.

B. Non-insulated, Flexible Duct: UL 181, Class 1, multiple layers of aluminum laminate supported by helically wound, spring-steel wire.
   1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
   3. Temperature Range: Minus 20 to plus 210 deg F.

C. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.
   1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
   3. Temperature Range: Minus 10 to plus 160 deg F.

D. Flexible Duct Connectors: Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action.
2.13 SOUND BOOTS

A. Plenum ceiling return grille sound boots shall be fabricated from sheet metal with 1-inch liner. Sound boots shall be a 90-degree elbow with the vertical leg sized to the grille and the horizontal leg cross-section 50% of the grille face area and extending horizontally from the vertical leg the length of the grille long dimension.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Duct Installation:

1. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install ductwork systems including field identified offsets and adjustments required to avoid conflict with building construction and other conditions. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings, Coordination Drawings, or Requests for Information.

2. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.


4. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

5. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

6. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

7. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

8. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

9. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

10. Where ducts pass through fire-rated interior partitions and exterior walls in unsprinkled buildings, install fire dampers.

11. All ductwork shall be fabricated and installed so that no undue vibration or noise results. Joints per seal class shall be sealed airtight with additional taping and caulking provided if necessary.

12. Provide all necessary manual, backdraft, and relief dampers as required for proper adjustment and control of air distribution.

   a. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

   b. Install steel volume dampers in steel ducts.

   c. Install aluminum volume dampers in aluminum ducts.

   d. Set dampers to fully open position before testing, adjusting, and balancing.

13. At all places where inside of duct will be visible through grilles, louvers, etc., paint visible inside portion of duct flat black.

14. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
a. On both sides of duct coils.
b. Upstream from duct filters.
c. At outdoor-air intakes and mixed-air plenums.
d. At drain pans and seals.
e. Downstream from manual volume dampers, backdraft dampers, and equipment.
f. Upstream or downstream of control dampers.
g. Upstream or downstream security bars.
h. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers. Paint access doors red.
i. At each change in direction and at maximum 50-foot (15-m) spacing.
j. Upstream [and downstream] from turning vanes.
k. Upstream or downstream from duct silencers.
l. Control devices requiring inspection.
m. Elsewhere as indicated.

15. Install access doors to swing against static
16. Install flexible connectors to connect ducts to equipment.
17. Transitions in ductwork, in changing shapes and sizes, shall be made with angles not exceeding 15 degrees (diverging) or 30 degrees (converging) wherever possible.
18. Flexible duct shall be used on supply diffuser run outs only, and only where indicated. Flexible ducts shall be installed using lengths not exceeding 8 feet (low-pressure) to make the connection. Duct shall be suspended at intervals not exceeding 5 feet with a minimum 1-inch-wide, 22-gauge steel band. Maximum allowable sag is 1/2 inch per foot of spacing between supports.
19. Flexible duct shall be installed such that obstructions do not crush, distort or otherwise intrude on the flexible duct.
20. Contractor shall not provide holes in the duct systems for the installation of hangers for other equipment. Work of all other trades shall be so coordinated as to render this unnecessary.
21. At ends of ducts that are not connected to equipment, ductwork, or air distribution devices at time of ductwork installation, provide a temporary closure of plywood or corrugated cardboard backed polyethylene film or other covering that will prevent entrance of moisture, dust, and debris and duct leakage until time connections are to be completed.

B. Installation of Exposed Ductwork
1. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
2. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
3. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
4. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
5. Repair or replace damaged sections and finished work that does not comply with these requirements.

C. Additional Installation Requirements for Commercial Kitchen Hood Exhaust Duct
1. Kitchen exhaust ducts shall be welded throughout and installed in accordance with NFPA 96 (Standard for the Installation of Equipment for the Removal of Smoke and Grease-Laden Vapors from Commercial Cooking Equipment) and the International Mechanical Code. Exposed ductwork from hood to the ceiling shall be 18-gauge type 316 stainless steel with welded joints and connections.
2. Install commercial kitchen hood exhaust ducts without dips and traps that may hold grease, and sloped a minimum of 2 percent to drain grease back to the hood.

DUCTS AND ACCESSORIES
23 31 00 - 11
3. Install fire-rated access panel assemblies at each change in direction and at maximum intervals of 12 feet, in horizontal ducts, at both sides of each change in direction 45° or greater, and at every floor for vertical ducts, and as further indicated on Drawings. Locate access panel on top or sides of duct a minimum of 1-1/2 inches from bottom of duct.

4. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.

D. Duct Penetrations through Wall and Floors:
1. Provide 1-inch angle collars for all exposed ducts passing through walls, ceilings, or floors. Anchor collars in position after installation is complete.
2. Where vertical ducts pass through floors, supporting angles shall be rigidly attached to ducts and to the floor. Angles shall be galvanized and of approved sizes to properly support the ductwork. The supporting angles shall be placed on at least two sides of the duct.
3. Where horizontal ducts pass through walls and vertical ducts pass through floors, opening shall be tightly sealed off so as to provide a tight seal between duct and opening. Refer to Division 7 for approved fire stop materials to be used at all rated walls and floors.

3.02 DUCT PROTECTION
1. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction."
2. Store duct sections on jobsite in clean, dry area. Duct ends and openings shall be covered and protected from dirt and moisture.
3. Cover and protect duct openings from dirt and moisture during and after erection.
4. Cover return ducts openings with MERV 8 filters whenever air handlers are operated during construction.
5. Provide weekly, dated photographs of protected stored material, protected installed material, and installed filters. Provide provide photographs on a more frequent basis as required by other requirements of the project.
6. Submit statement and photographs documenting duct protection.

3.03 SEALING OF DUCTS
A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
2. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-inch wg and Lower: Seal Class C.
3. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-inch wg: Seal Class B.
4. Conditioned Space, Exhaust Ducts: Seal Class B.
5. Conditioned Space, Return-Air Ducts: Seal Class C.

3.04 HANGER AND SUPPORT INSTALLATION
A. Install hangers and supports for metal ducts and fittings to comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
B. Attachments and Spacing
1. Building Attachments: Verify attachment methods with structural drawings. Use concrete inserts, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
2. Where practical, install concrete inserts before placing concrete.
3. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
4. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches (100-mm) thick.
5. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100-mm) thick.
6. Do not use powder-actuated concrete fasteners for seismic restraints.
7. Hanger Spacing: Comply with SMACNA for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection unless more restrictive by SMACNA.
8. Hangers Exposed to View: Threaded rod and angle or channel supports.
9. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
10. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.05 LIFE SAFETY DAMPERS

A. Install all fire, smoke, and combination fire/smoke dampers in strict accordance with UL listing, NFPA 90A, 90B, 92A, IMC, and manufacturer’s requirements. Sleeves and methods of support shall be as detailed in manufacturer’s UL instructions, in NFPA documents, or per local codes if more stringent. Apply firestopping material only if specified in manufacturer’s installation instructions.

B. Provide access doors (labeled per the applicable codes and painted red) located to provide access to all fire, smoke, and combination fire/smoke dampers, except fire dampers located behind removable grilles and diffusers will not require duct access doors unless access through removable device is not practical.

3.06 DAMPERS

A. Install control dampers furnished by Division 23 Section "HVAC-Instrumentation and Controls for HVAC," at locations shown on drawings.

B. Install backdraft and control dampers on exhaust fans as near the building envelope exit as possible, unless otherwise indicated on drawings.

3.07 CONNECTIONS

A. Provide flexible and fabric connections at inlet and discharge duct connections to in-line fans, fan coil units and air handling equipment, except when fans are internally isolated. Flexible connections shall be securely fastened to the duct and equipment per SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible." Allow at least 1 inch of slack.

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.08 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer.

B. Paint access doors to life safety dampers red.

C. Paint materials and application requirements are specified in Division 09 painting Sections.

3.09 FIELD QUALITY CONTROL

A. Perform tests and inspections.
B. Tests and Inspections:
1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Inspect turning vanes for proper and secure installation.

C. Leakage Tests
2. Test the following systems:
   a. Contractor shall, at the beginning of the work, construct, erect, and leak test a representative sample of the duct construction to be used at the +3-inch w.g. pressure class. The sample specimen shall include at least five transverse joints, typical seams, an access door, and at least two typical branch connections plus an elbow. Tests and necessary repair shall be completed prior to concealment of any ducts.
3. Test for leaks before applying external insulation.
4. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
5. The leakage amount shall not exceed the allotted amount for the pressure class or the allotted amount for that portion of the system, whichever is applicable.

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<thead>
<tr>
<th>Duct Construction Class</th>
<th>Leakage Class</th>
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<tbody>
<tr>
<td></td>
<td>Rectangular</td>
</tr>
<tr>
<td>4-inch to 10-inch w.g.</td>
<td>6</td>
</tr>
<tr>
<td>3-inch w.g.</td>
<td>12</td>
</tr>
<tr>
<td>2-inch w.g.</td>
<td>24</td>
</tr>
</tbody>
</table>

Note: Refer to Part 1 for leakage criteria.

6. Leakage test procedures shall follow the outlines and classifications in the SMACNA HVAC Duct Leakage Test manual.
7. Give seven days' advance notice for testing.

D. Duct System Cleanliness Tests:
1. Visually inspect duct system to ensure that no visible contaminants are present.
2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
   a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

E. Duct system will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

3.10 DUCT CLEANING
A. Clean new and existing duct system(s) before testing, adjusting, and balancing.
B. Use service openings for entry and inspection.
   1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with this section for access panels and doors.
   2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Particulate Collection and Odor Control:
1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

D. Clean the following components by removing surface contaminants and deposits:
1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
7. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:
1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer’s written instructions after removal of surface deposits and debris.

F. Duct Systems: Strip protective paper from stainless ductwork surfaces, and repair finish wherever it has been damaged.

3.11 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:
1. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Supply Ducts:
1. Ducts Connected to Terminal Units:
   a. Pressure Class: Positive 1-inch w.g.
   b. Minimum SMACNA Seal Class: B.
   c. SMACNA Leakage Class for Rectangular: 24.
   d. SMACNA Leakage Class for Round: 12.
2. Ducts Connected to Variable-Air-Volume Air-Handling Units:
   a. Pressure Class: Positive 3-inch w.g.
   b. Minimum SMACNA Seal Class: A.
   c. SMACNA Leakage Class for Rectangular: 6.
   d. SMACNA Leakage Class for Round: 3.

C. Return Ducts:
   1. Ducts Connected to Air-Handling Units:
      a. Pressure Class: Positive or negative 2-inch w.g.
      b. Minimum SMACNA Seal Class: B.
      c. SMACNA Leakage Class for Rectangular: 12.
      d. SMACNA Leakage Class for Round: 6.

D. Intermediate Reinforcement:
   2. PVC-Coated Ducts: Match duct material
   3. Stainless-Steel Ducts: Match duct material

E. Elbow Configuration:
   1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
      a. Radius Type RE 1 with minimum 1.5 radius-to-width ratio.
      b. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," with 1-1/2-inch spaced and 2-inch radius, small single width vanes and Figure 2-4, "Vane Support in Elbows."
   2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
      a. Minimum radius-to-diameter ratio shall be 1.5 and elbow segments shall be 5: Elbows with less than 90-degree change of direction have proportionately fewer segments.
      b. Radius-to-Diameter Ratio: 1.5.
      c. Round Elbows, 12 inches and Smaller in Diameter: Stamped or pleated.
      d. Round Elbows, 14 inches and Larger in Diameter: Standing seam or Welded.

F. Branch Configuration:
   1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connections."
      a. Rectangular Main to Rectangular Branch: 45-degree entry.
      b. Rectangular Main to Round Branch: Conical spin-in.
      c. Branch to Run Out: Conical spin-in with damper.
   2. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
      a. Velocity to 1500 fpm: Conical tap.
      b. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION
SECTION 233600

AIR TERMINAL UNITS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specifications, apply to this Section.

1.02 SUMMARY

A. Section Includes: This section covers the general requirements for air terminal units including:
   1. Variable air units

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's technical and performance data for all air terminal units:
   1. Submittal data for each air terminal unit shall include:
      a. Primary air inlet size
      b. Primary air design cfm as scheduled
      c. Primary air maximum airflow without exceeding specified sound levels
      d. Primary air minimum cfm as scheduled
      e. Primary air minimum controllable airflow
   2. Submittal data for each fan-powered unit shall also include:
      a. Type of fan speed control
      b. Unit discharge airflow with fan or high speed
      c. Minimum airflow delivered at lowest fan speed setting

B. Wiring Diagrams: Submit wiring and control diagrams for air terminal units.

1.04 QUALITY ASSURANCE


PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Approved Manufacturers: ETI, Nailor, Price, and Titus.

2.02 VARIABLE AIR VOLUME

A. Casing: 0.034-inch steel sheet metal.
   1. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2007.
   2. Lining: 1-inch-thick, coated, fibrous-glass or cotton duct liner complying with ASTM C 1071; secured with adhesive.
B. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.
   1. Maximum Damper Leakage: ARI 880 rated, 2 percent of nominal airflow at 3-inch wg inlet static pressure.

C. Hot-Water Heating Coil: Copper tube, mechanically expanded into aluminum-plate fins; leak tested underwater to 200 psig (1380 kPa); and factory installed.

D. All terminal units shall be pressure independent type. Terminal unit capacities and configuration shall be as scheduled on the drawings. Units shall have factory catalog performance ratings that match or exceed those indicated on the drawing schedules.

E. Terminal units shall have flow taps with calibration chart on unit for airflow measuring and balancing.

F. Provide quick-opening gasketed-type access door(s) as required to permit access to all internally mounted devices which may require adjustment, lubrication, and/or replacement, such as volume controllers, damper actuators, fans and motors, etc.

G. Air terminals shall be selected so required dB sound levels are not exceeded at 1.5-inch w.g. inlet pressure. Both unit casing radiated sound levels and discharge sound levels shall be considered in terminal unit selection.

H. Variable Air Volume Terminal Units:
   1. Configuration: Volume-damper assembly inside unit casing with control components located inside a protective metal shroud.
   2. Maximum wide-open static pressure requirement for box shall be 0.35-inch w.g.
   3. Maximum flow (and minimum flow rates on VAV units) shall be field-adjustable.
   4. Shall have cross type averaging flow element in primary air inlet for air volume control.
   5. Provide access doors upstream and downstream of all reheat coils.

2.03 TEMPERATURE CONTROLS

A. The building DDC system Contractor to furnish DDC controls including all actuators and controllers. When requested by the DDC system contractor, terminal unit controls shall be factory mounted and wired at his expense.

B. Refer to the Section 23 09 93 for Sequence of Operation descriptions.

2.04 SOURCE QUALITY CONTROL

A. Terminal units shall be tested and rated in accordance with ARI 880 "Industry Standard for Air Terminals" and shall bear the ARI certification seal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Support terminal units from structure using threaded rod and brackets. Install terminal unit to allow complete access to controls. Mount fan powered boxes with Specification “D” isolators in Division 23 Section “Common Work Results for HVAC.”
B. Inlet branch duct(s) shall be rigid medium-pressure duct with a minimum of 3 feet of straight duct ahead of unit inlet(s).
   1. Arrange medium-pressure ducts and takeoffs so there are no more than two elbows or bends up to 90-degrees in branch duct to inlet(s); "U" bends will not be allowed.

C. Water Coil Piping Connections: Provide shut-off valves, P & Ts, flow measurement and balancing valve, drain and air vent, and as further detailed on drawings.

D. Provide a minimum of 5 feet of lined low-pressure ductwork prior to first spin-in fitting or supply air outlet branch duct takeoff.

E. Coordinate terminal unit installation with the building DDC system contractor.

END OF SECTION
SECTION 233700

AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specifications, apply to this Section.

1.02 SUMMARY

A. Section Includes: This section covers the general requirements for grilles, registers, and diffusers, louvers and intake and relief hoods.

1.03 DEFINITIONS

A. Diffuser: Circular, square, or rectangular air distribution outlet, generally located in the ceiling and comprised of deflecting members discharging supply air in various directions and planes and arranged to promote mixing of primary air with secondary room air.

B. Grille: A louvered or perforated covering for an opening in an air passage, which can be located in a sidewall, ceiling, or floor.

C. Register: A combination grille and damper assembly over an air opening.

1.04 SUBMITTALS

A. Product Data:
   1. For each model indicated, include the following:
      a. Data Sheet: For each type of air outlet and inlet, and accessory furnished; indicate construction, finish, and mounting details.
      b. Performance Data: Include throw and drop, static-pressure drop, and noise ratings for each type of air outlet and inlet.
      c. Schedule of diffusers, registers, and grilles indicating drawing designation, room location, quantity, model number, size, and accessories furnished.
      d. Assembly Drawing: For each type of air outlet and inlet; indicate materials and methods of assembly of components.
   2. Provide sufficient submittal data for air distribution devices to verify that required space sound levels will not be exceeded.

1.05 SYSTEM DESCRIPTION

A. Performance Criteria: All equipment and material furnished under this section shall be selected so required RC sound levels in various spaces are not exceeded. Attenuation by ceilings, duct liner, and room absorption may be taken into account when making fan, terminal unit, and air distribution selections. Refer to the latest edition of the ASHRAE Applications Handbook for further information.
PART 2 - PRODUCTS

2.01 GRILLES, REGISTERS, AND DIFFUSERS

A. Approved Manufacturers: Metalaire, Nailor, Price, and Titus.

B. Air outlets and inlets shall be performance tested and rated in accordance with ADC Test Code 1062 and ASHRAE Standard 70.

C. Provide grilles, registers, diffusers, slots, and accessories of size and type as indicated and/or scheduled on the drawings. Select devices so required space RC sound levels are not exceeded.

D. All grilles, registers, and diffusers shall have white baked-on enamel finish.

E. Provide ceiling grilles, registers, and diffusers with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling module with accurate fit and adequate support. (Refer to general construction drawings and specifications for types of ceiling systems which will contain each type of ceiling diffuser.)

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Grilles, Registers, and Diffusers:
   1. Grilles, registers, and diffusers shall be installed level and plumb and supported per manufacturer’s recommendations and per the International Building Code.
      a. Ceiling-mounted air devices (supply diffusers and/or return and exhaust grilles and registers) or services weighing less than 20 pounds shall be positively attached to the ceiling suspension main runners or to cross runners with the same carrying capacity as the main runners.
      b. Devices or services weighing 20 pounds, but not more than 56 pounds, in addition to the above, shall have two 12-gauge hangers connected from the device or service to the ceiling system hangers or to the structure above. These wires may be slack.
      c. Air devices or services weighing more than 56 pounds shall be supported directly from the structure above by approved hangers.
   2. Ductwork visible behind grilles, registers, and diffusers shall be painted flat black.
   3. Install diffusers, registers, and grilles with airtight connection to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.
   4. Refer to architectural reflected ceiling plan for locations of grilles, registers and diffusers.

3.03 ADJUSTING

A. Grilles, Registers, and Diffusers: Throw patterns (directions) shall be furnished and/or adjusted to match those shown and/or scheduled on the drawings.

END OF SECTION
COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.01 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.
   9. "Supply": To purchase, procure, acquire and deliver complete with related accessories.
   10. "Wiring": Raceway, fittings, wire, boxes and related items.

1.02 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. Network Lighting Controls
   2. Contactors
   3. Wiring Devices
   4. Interior and Exterior Lighting
   5. Hangers and Supports for Electrical Systems
   6. Grounding and Bonding
   7. Multi-Outlet Assemblies
   8. Electrical Systems Control
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.

1.03 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.

3. NECA - Standard of Installation.
5. IEEE – The Institute of Electrical and Electronics Engineers.
7. The University/Anschutz Medical Campus Project Guidelines and Standards.
8. International Building Code in accordance with the Campus Building Official.
9. ASTM - American Society of Testing Materials
10. IPCEA - Insulated Power Cable Engineers Association
11. Underwriter's Laboratories (UL)
12. American National Standards Institute (ANSI)
13. 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, Subcontractors 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.

1.04 DELIVERY, STORAGE AND HANDLING

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

1.05 WARRANTY

B. All electrical equipment, materials and workmanship warranties shall be provided in accordance with the requirements of Section 01 78 36 and the following:

I. The Contractor warranties 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

2.01 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.

D. Fire Seals:
1. Material: Fire stopping material shall be asbestos free, 100% intumescent, have code approval under BOCA, ICBO, SSBC, NFPA 101, NFPA 70, and be capable of maintaining an effective barrier against flame and gases in compliance with the following requirements.

2. Flame Spread: 25 or less, ASTM E84

3. Fire Resistance and Hose Stream Tests: Fire stopping materials shall be rated “F” and “T” in accordance with ASTM E 814 or UL 479. Rating periods shall conform to the following:

| (F) | 3 | (T) | 3 | Time-rated floor or wall assemblies. |
| (F) | 3 | (T) | 3 | Openings between floor slabs & curtain wall. |

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

A. Construct Work in sequence under provisions of Division I 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. All home runs to panel boards are indicated as starting from outlet nearest panel and continuing in general direction of that panel. Continue such circuits to panel as though routes were completely indicated.

R. Furnish and install all necessary hardware, hangers, blocking, brackets, bracing, runners, etc. required for equipment specified under this Division.

S. Remove all unused or abandoned conduit, junction boxes, panels, and other electrical components back to the source.

T. Provide GFCI type receptacles for all "above counter" receptacles located within 6' of any sink or basin.

U. Clean all luminaries, lamps and lenses prior to final acceptance. Replace all inoperative lamps.
V. 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.

3.02 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. Test Reports:

1. Test Reports: Submit three (3) copies of test results.

2. The final University inspection of the project will not be made until a satisfactory report is received and approved by the University Project Manager.

3. Results shall include:
   a. Insulation resistance readings for all motors and motor feeders 5 horsepower or greater.

C. 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.

3.03 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
SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART I - GENERAL

1.01 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

1.02 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.

1.03 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.

1.04 WARRANTY

A Wire and cable warranties shall be provided in accordance with the requirements of section 26 05 00
PART 2 - PRODUCTS

2.01 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.

2.02 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/THW or XHHW insulation, rated 600 volt.
   2. Conductors: Provide solid conductors for power and lighting circuits #2 AWG and smaller. Provide stranded conductors for #0 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:
      a. Where conduit temperature will exceed 100 degree F, use type THHN (90 degree C). Type XHHW (90 degree C) permissible in dry locations.
      b. In 120-volt incandescent fixtures, type AF (150 degree C).
      c. In wire ways of fluorescent lighting fixtures types THW-MTW, THHN (90 degree C).
   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 insulated wire.
   7. Type NM, NMC, NMS cable are not acceptable for any application.
   8. Use copper wire only.
   9. No wire splices shall be allowed in the conduit or conduit fittings. All splices shall be done in an approved box.
I0. Grounding conductors shall be copper type THHN with green integrally-colored insulation, sized to meet NEC.

II. Plenum rated cable when required by Plenum conditions.

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. Wiring to Light Fixtures:
   1. Type THHN to fluorescent light fixtures, l2-gauge minimum.
   2. Type THHN to incandescent fixtures, l2-gauge minimum.

D. 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

3.01 EXAMINATION

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

3.02 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. BAS Conductor installation: (see Section 23 09 l3)

   D. Wires and Cables:
      1. On systems greater than 600V thoroughly swab raceway before installing wire. Pull conductors simultaneously where more than one is being installed in same raceway. Use pulling compound or lubricant on all cable installations. compound used shall not deteriorate conductor or insulation.
      2. 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.
3. 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.

4. Install splices and tapes, which possess equivalent or better mechanical strength and insulation ratings than conductors being spliced.

5. 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.

6. 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.

7. 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.

8. 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.

9. Use split bolt connectors for copper wire splices and taps, 6 AWG through 1 AWG. Tape un-insulated conductors and connectors with electrical tape to 150% of the insulation value of conductor. Rubber, friction and 3M-33 or 88 or better. Two (2) layers minimum each.

10. Use copper compression connectors for copper wire splices and taps, 1/0 AWG and larger. Tape un-insulated conductors and connectors with electrical tape to 150% of the insulation value of the conductor. Rubber, friction and 3M-33 or 88.

Guidelines and Design Standards

11. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.

12. Thoroughly tape the ends of spare conductors in boxes and cabinets.

13. Install exposed cable, parallel and perpendicular to surfaces, or exposed structural member, and follow surface contours, where possible.

14. 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.

15. Parallel conductors shall be cut to the same length and be the same type of wire.

16. All splices in control panels, terminal junction boxes, low voltage control circuits and fire alarm conductors shall be on numbered terminal strip.

17. When routed in a wall, install all thermostat wire, fire alarm, computer cable, low voltage cable, and other communication cable in conduit.

18. All junction boxes shall be fully accessible.

19. All wiring shall be routed through an acceptable raceway regardless of voltage application, unless specified otherwise under other sections of these standards.
3.03 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.

3.04 SCHEDULES

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

<table>
<thead>
<tr>
<th>120/208 Volts</th>
<th>Phase</th>
<th>277/480 Volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>A</td>
<td>Brown</td>
</tr>
<tr>
<td>Red</td>
<td>B</td>
<td>Orange</td>
</tr>
<tr>
<td>Blue</td>
<td>C</td>
<td>Yellow</td>
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<tr>
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<td>Neutral</td>
</tr>
<tr>
<td>Green</td>
<td></td>
<td>Gray</td>
</tr>
<tr>
<td>Switch leg - Pink</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 &amp; 4 way travelers - Purple</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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
PART I - GENERAL

1.01 DESIGN REQUIREMENTS

A. Provide equipment supports rated for the supported loads.

PART 2 - PRODUCTS

2.01 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: l6-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. J-Hooks and Bridle Rings
   1. J-hooks and bridles may be used to support low voltage wiring systems.

K. The following are prohibited.
   1. Plastic or fiber anchors.
   2. Drilling or structured steel

PART 3 - EXECUTION

3.01 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 ½ 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, busways, 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 metalscrews.

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.

H. Telecommunications Systems Cable Supports: Use cable tray or telecommunications approved cable supports.
SECTION 26 05 33

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - PRODUCTS

1.01 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
   4. Wire ways:
      a. Hinged cover or screw cover complete with all necessary fittings which shall be of one manufacturer.

1.02 MATERIALS, GENERAL

A. Metal Conduit and Tubing:
   1. Galvanized Steel Rigid Conduit (GRC):
      a. Conduit: Provide rigid steel conduit, hot-dipped galvanized with threaded ends Fittings: Threaded galvanized steel, bushings shall have nylon-insulated throat.
   2. 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.
   3. Intermediate metal conduit (IMC)
      a. Conduit: Provide intermediate steel conduit hot-dipped galvanized Fittings: Threaded galvanized steel, bushings shall have nylon-insulated throat.
   4. Rigid Aluminum Conduit:
      a. Not allowed unless otherwise noted.
   5. 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 1/2 inch.

6. 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.

7. Non-metallic Rigid Conduit
   a. PVC plastic schedule 40

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.

PART 2 – PRODUCTS

2.01 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 3 - EXECUTION

3.01 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. Rigid Galvanized conduit or intermediate metallic steel conduit shall be installed in the following areas.
      a. All outdoor non-conditioned locations concealed and exposed.
      b. Interior exposed. Below 10 feet to floor. PVC coated 90 degree elbows underground when penetrating floor slabs.
   2. 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.
   3. 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.
   4. Non-metallic Rigid Conduit:
      a. In concrete and underground.
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. Telecommunications and Signal Systems Raceways: Refer to Section 27 05 28 Pathways for Communications.

15. Install raceway-sealing fittings in accordance with the manufacturer’s written instructions. Locate fittings at suitable, approved, accessible locations and fill them with UL Listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway-sealing fittings at the following points and elsewhere as indicated:
   a. Where conduits enter or leave hazardous locations.
   b. Where conduits pass from warm locations to cold locations, such as the boundaries of refrigerated spaces and air-conditioned spaces.
   c. Where required by the NEC.

16. 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.

17. Conduit Seals: Conduit passing through concrete walls shall be sealed.

18. 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.

19. Ream the ends of all cut and/or threaded conduit. Ends shall be cutsquare.

20. Use of running threads for rigid metallic conduit are not permitted. When threaded couplings cannot be used, provide 3-piece union or solid coupling.

21. Conduits shall not cross pipe shafts or ventilation duct openings “access panel”.

22. 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.

23. Install an insulated ground conductor in all conduits.

24. 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.

25. 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. Campus Guidelines and Design Standards

26. Provide separate raceway systems for each of the following:
   a. Lighting
b. Power Distribution

c. Emergency (Essential)
   1) Lighting
   2) Power distribution

d. Low voltage systems, including telephone and communications, EQ alarm, security, fire alarm.

e. Audio/Visual

27. 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.

28. 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.

29. 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.

30. All underground raceways, not under the building footprint, shall be installed so it slopes away from the building.

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.

3.02 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

Campus Guidelines and Design Standards

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. Fire rated poke-through shall be installed in areas to miss beams and ductwork in ceiling below. Floors shall be X-rayed before core drilling.
5. 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.
6. 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.
7. 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.
8. 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.
9. Ceiling outlets: For fixtures, where wiring is concealed, use outlet boxes 4-inches square by 1-1/2 inches deep, minimum.
10. Protect outlet boxes to prevent entrance of plaster, and/or debris. Thoroughly clean foreign material from boxes before conductors are installed.
11. Concrete boxes: Use extra deep boxes to permit side conduit entrance without interfering with reinforcing, but do not use such boxes with over 6-inch depth.
12. 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.
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:
Campus Guidelines and Design Standards
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
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART I - GENERAL

1.01 DESIGN REQUIREMENTS

A. All electrical equipment and systems shall be properly labeled in accordance with this section. It includes requirements for electrical identification components including but not limited to the following:
   1. Identification labeling for raceways, cables, and conductors.
   2. Equipment labels and signs.

1.02 SUBMITTALS

1. Samples of each color, lettering style, and other graphic representation required for identification materials; samples of labels and signs.

PART 2 - PRODUCTS

2.01 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.

2.02 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 3 - EXECUTION

3.01 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 System Raceways with Color Banding: Band exposed or accessible raceways of the following systems for identification. Bands shall be pre-tensioned, snap-around colored plastic sleeves, colored adhesive marking tape, or a combination of the two. Make each color band 2 inches wide, completely encircling conduit, and place adjacent bands of two-color markings in contact, side by side. Install bands at changes in direction, at penetrations of walls and floors, and at 40-foot maximum intervals in straight runs. Provide Brady B-946 vinyl or equivalent. Colored duct tape is not acceptable.

   Apply the following colors:
   1. Security System: Blue and Yellow with Gray Cable.
   2. Telecommunications System: Green and Yellow with Blue and White Cables.
   6. Lighting Control Cabling shall be Green.

E. 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.

F. 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.

G. Install equipment/system circuit/device identification as follows:

   1. Apply equipment identification labels of engraved plastic-laminate on each major unit of electrical equipment in building, including central or master unit of each electrical system. This includes communication/signal/alarm systems, unless the unit is specified with its own self-explanatory identification. Text shall match terminology and numbering of the Contract Documents and shop drawings. Identification must include equipment name, voltage, phase, amperage, and fed from. Apply labels for each unit of the following categories of electrical equipment.

      a. Switchboards, switchgear, panelboards and enclosures, 1/2” high lettering.
      b. Access doors and panels for concealed electrical items, 1/4” letters
      c. Transformers 1/2” high letters.

H. 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.

I. 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.

IDENTIFICATION FOR ELECTRICAL SYSTEMS
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J. Install labels at locations indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment.

K. 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
SECTION 26 27 26

WIRING DEVICES

PART I - GENERAL

1.01 DESIGN REQUIREMENTS

A. Plug-in type devices are not acceptable.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturers: Subject to compliance with requirements, provide wiring devices of one of the following:
   1. Devices:
      a. Harvey Hubbell Inc.
      b. Leviton Mfg. Co.
      c. Pass and Seymour Inc.
      d. Bryant Electric Co.
      e. General Electric Co.
   2. Wall (Local) Switches: Numbers used below are those of Hubbell. Equivalent Cooper, P & S, or Leviton.
   3. Fire Rated Poke-through Receptacle: Hubbell systems or approved equal.
   4. Multi-Outlet Assembly (MOA): Hubbell or Wiremold.

2.02 MATERIALS, GENERAL

A. Receptacles:
   1. Duplex receptacles shall be of the heavy-duty type, NEMA 5-20R configurations. 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 I; 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. Standby Receptacles: Single or duplex minimum 20-amp, color red.
   5. Isolated Ground Circuit: Single or duplex minimum 20-amp, color orange, with isolated ground.
   7. Telephone or CRT Receptacles: 4 inch square box with one gang plaster ring and 5/8 inch diameter grommet hole split plate.
   8. 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.
   9. Fire Rated Poke-through: Provide where shown on drawings. Poke-through shall provide services as shown on drawings and have a carpet saver feature.
B. Switches:
1. Wall Switches for Lighting Circuits: NEMA WDI; 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. Handle: Red for emergency power circuits. Verify color for normal power devices with Engineer prior to ordering.
3. Pilot Light Type: Lighted handle lit when switch is "on."
4. Locator Type: Continuously lighted handle.

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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.
3.02 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.

3.03 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