NOTICE TO BIDDERS

SMALL BUSINESS RESERVE PROCUREMENT

This is a Small Business Reserve Procurement for which award will be limited to Certified Small Business vendors. Only businesses that meet the statutory requirements set forth in State Finance and Procurement Article, §§ 14-501 - 14-505, Annotated Code of Maryland, and who are registered with the Department of General Services Small Business Reserve Program are eligible for award of a contract.

For the purposes of a Small Business Reserve Procurement, a small business is a business, other than a broker, that meets the following criteria:

- The business is independently owned and operated;
- The business is not a subsidiary of another business;
- The business is not dominant in its field of operation;
- The wholesale operations of the business did not employ more than 50 persons, and the gross sales of the business did not exceed an average of $4,000,000 in its most recently completed 3 fiscal years;*
- The retail operations of the business did not employ more than 25 persons, and the gross sales of the business did not exceed an average of $3,000,000 in its most recently completed 3 fiscal years;*
- The manufacturing operations of the business did not employ more than 100 persons, and the gross sales of the business did not exceed an average of $2,000,000 in its most recently completed 3 fiscal years;*
- The service operations of the business did not employ more than 100 persons, and the gross sales of the business did not exceed an average of $10,000,000 in its most recently completed 3 fiscal years;* and
- The construction operations of the business did not employ more than 50 persons, and the gross sales of the business did not exceed an average of $7,000,000 in its most recently completed 3 fiscal years.*
- The architectural and engineering services of the business did not employ more than 100 persons and the gross sales of the business did not exceed an average of $4,500,000 in its most recently completed 3 fiscal years.

* If a business has not existed for three years, the gross sales average shall be the average for each year or part of a year during which the business has been in existence.

Further information on the certification/registration process is available at e-Maryland Marketplace.
INVITATION FOR BIDS

7800 YORK ROAD 1ST & 2ND FLOOR RENOVATION
TU-1949-SBR

PROSPECTIVE BIDDERS/OFFERORS WHO OBTAINED THIS DOCUMENT FROM THE UNIVERSITY’S WEBSITE, E-MARYLAND MARKETPLACE, OR ANY SOURCE OTHER THAN THE PROCUREMENT OFFICER, SHOULD PROVIDE THEIR NAMES AND EMAIL ADDRESSES TO THE ISSUING OFFICE BY CONTACTING (410) 704-2171, TO ENSURE RECEIPT OF ADDENDA AND OTHER COMMUNICATIONS REGARDING THE SOLICITATION.

ISSUING OFFICE
PROCUREMENT DEPARTMENT
8000 YORK ROAD
TOWSON, MD 21252-0001

NOTE:
IF YOU PLAN TO HAND DELIVER YOUR BID/PROPOSAL OR USE AN OVERNIGHT COURIER, DELIVER THE BID TO THE PROCUREMENT OFFICE LOCATION TO ENSURE TIMELY DELIVERY.

PROCUREMENT OFFICE LOCATION
ADMINISTRATION BUILDING
7720 YORK ROAD, 4TH FLOOR
TOWSON, MD 21204

FREE 20-MIN. PARKING METERS ARE AVAILABLE NEAR THE 1ST-FLOOR BUILDING ENTRANCE

DIRECTIONS TO THE UNIVERSITY AND A CAMPUS MAP
http://www.towson.edu/maps/index.html

PARKING INFORMATION
http://www.towson.edu/parking/visitors/index.html

MINORITY BUSINESSES ARE ENCOURAGED TO RESPOND TO THIS SOLICITATION
### Invitation for Bids (IFB)

**7800 York Road 1st & 2nd Floor Renovations**

<table>
<thead>
<tr>
<th><strong>IFB Issue Date:</strong></th>
<th>2/19/19</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IFB Issuing Office:</strong></td>
<td>Towson University Procurement Department</td>
</tr>
<tr>
<td><strong>Procurement Officer Representative:</strong></td>
<td>Michelle Compton</td>
</tr>
<tr>
<td><strong>Phone:</strong></td>
<td>410-704-2050</td>
</tr>
<tr>
<td><strong>Fax:</strong></td>
<td>410-704-8233</td>
</tr>
<tr>
<td><strong>e-mail:</strong></td>
<td><a href="mailto:MLCompton@towson.edu">MLCompton@towson.edu</a></td>
</tr>
<tr>
<td><strong>Procurement Office Location:</strong></td>
<td>Towson University Procurement Department Administration Building, 4th Floor 7720 York Road Towson, MD 21204</td>
</tr>
<tr>
<td><strong>Pre-Bid/Proposal Conference:</strong></td>
<td>2/22/19 – 11:00 AM – 1st site visit immediately following Pre-Bid/Proposal Conference Administration Building, Room 408 2nd Site Visit: 2/26/19 @ 10:00 AM Meet in the 1st Floor Lobby of the Administration Building <strong>Note: One site visit is mandatory</strong></td>
</tr>
<tr>
<td><strong>Deadline for Questions:</strong></td>
<td>3/1/19 – 4:30 PM</td>
</tr>
<tr>
<td><strong>Bids Due:</strong></td>
<td>3/8/19 – 2:00 PM (public bid opening) Administration Building, Room 408</td>
</tr>
</tbody>
</table>

The University is committed to ensuring that persons with disabilities have equally effective opportunities to participate in and benefit from the University's programs and services. Persons who may require reasonable ADA accommodations should contact the Issuing Office at 410-704-2171 at least five (5) days prior to any meeting scheduled in connection with this solicitation.
UNIVERSITY SYSTEM OF MARYLAND
TOWSON UNIVERSITY
NOTICE TO BIDDERS/OFFERORS

To help improve the quality of bid and proposal solicitations and to make our procurement process more responsive and "business friendly," we ask that you provide comments and suggestions regarding the enclosed solicitation. Please return your comments with your bid, proposal or "no bid," response, as the case may be. Thank you for your assistance.

Bid/Proposal Number: TU-1949-SBR      Entitled: 7800 York Road 12st & s2nd Floor Renovation

I. If you have responded with a "no bid" please indicate the reasons below:
   ( ) Other commitments preclude our participation at this time.
   ( ) The subject of the solicitation is not something we normally provide.
   ( ) We are inexperienced in the work/commodities required.
   ( ) The specifications are either unclear or too restrictive (Explain below).
   ( ) The scope of work is beyond our current capacity.
   ( ) Doing business with Maryland Government agencies is simply too complicated (Explain below).
   ( ) We cannot be competitive (Explain below).
   ( ) Time allotted for completion of the bid/proposal response is insufficient.
   ( ) Startup time is insufficient.
   ( ) Bonding/Insurance requirements are prohibitive (Explain below).
   ( ) MBE requirements (Explain below)
   ( ) Bid/Proposal requirements (other than specifications or scope) are unreasonable or too risky (Explain below).
   ( ) Prior experience with Towson University contracts was unprofitable or otherwise unsatisfactory (Explain below).
   ( ) Payment schedule too slow.
   ( ) Other: _____________________________________________________________

II. If you have submitted a bid or proposal, but wish to offer suggestions or express concerns, please use the remarks section below.

Remarks: ____________________________________________________________________________

____________________________________________________________________________________

Offeror Name: _______________________________________________________________________
Contact Person: ______________________________________________________________________
Signature: ___________________________ Date: _____________________________
Address: ____________________________________________________________________________
E-Mail: ____________________________________________________________________________
Telephone: __________________________ Fax: ________________________________
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STANDARDS INTERIOR SIGNAGE
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STANDARDS TU IT INFRASTRUCTURE STANDARDS

BID PRICE PROPOSAL FORM

EXHIBITS
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Exhibit B  – Bid/Proposal Affidavit
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Exhibit E  – Minority Business Enterprise Participation Package
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Exhibit K  – Addenda Acknowledgment
Exhibit L  – Key Personnel Form

TERMS AND CONDITIONS
ATTACHMENT A - PREVAILING WAGE
SECTION I. PROCUREMENT OBJECTIVE

A. SUMMARY STATEMENT
TU is seeking qualified contractors to provide Towson University with General Contractor services for new fit out for the first floor (former Bateman’s restaurant space) and reconfiguration and renovation of an existing suite on the second floor. The renovation project will include general construction renovation including electrical, HVAC, fire suppression, and upgrades to the electronic access control system and the telecom system currently in place. Construction shall start on or about April 3, 2019 and be completed prior to July 26, 2019.

B. ISSUING OFFICE AND PROCUREMENT OFFICER
The sole point of contact in the State for purposes of this IFB is the Procurement Officer or his/her representative (hereinafter referred to as Procurement Officer) noted on the Key Information Summary Sheet. Only the information communicated by the Procurement Officer shall be deemed the official position of the University; no other State or University employee, official, or representative has authority to change the requirements of this solicitation. Attempts by Bidder to contact the requester, evaluator, or otherwise circumvent this procedure in any manner may be grounds for disqualification.

C. PRE-BID CONFERENCE AND SITE VISIT
1. Prior to submitting its bid, each contractor is encouraged to attend the scheduled pre-bid conference to examine the facility and familiarize himself with the full nature and extent of the work to be done. They shall obtain for themselves all information that may be necessary for the satisfactory performance of the contract work and the cost thereof. It is the sole responsibility of the contractor to fully familiarize themselves with the areas involved and the extent of the services required by visual inspection. Failure to visit the site and become familiar with the conditions and requirements affecting the work will not relieve the successful contractor from the provisions of the contract and from completing the work for the consideration set forth.

2. Two (2) site visits are scheduled and listed on the Key Information Summary Sheet. Please note: in order to be considered for award one (1) site visit is mandatory.

3. Towson University is committed to ensuring that persons with disabilities are given an equally effective opportunity to participate in and benefit from the university's programs and services. Persons with disabilities who might need reasonable accommodations should contact the Procurement Department at least 72 hours before any meetings held in connection with this solicitation at (410) 704-2171.

D. QUESTIONS AND INQUIRIES
Bidders shall direct all communications regarding this solicitation to the Procurement Officer, in writing (email preferred), not later than the date indicated on the Key Information Summary Sheet. Addenda, if required, will be furnished to all potential Bidders known to have received the IFB.

E. SITE INVESTIGATION
By submitting a bid the vendor acknowledges that he has investigated and satisfied
himself as to the conditions affecting the work, including but not restricted to those bearing upon transportation, disposal, handling and storage of materials, availability of labor, water, and electric power. Any failure by the contractor to acquaint himself with the available information will not relieve him from responsibility for estimating properly the cost of successfully performing the work. The University shall not be responsible for any conclusions or interpretations made by the contractor of the information made available by the University.

F. INSURANCE
Upon award, the successful bidder shall furnish certificates of insurance as required in Exhibit A, Required Contract Provisions, Section 51, naming Towson University as an additional insured. The certificate shall reflect the number and title of the solicitation/contract.

G. BID SECURITY
1. If the total Bid Price is $100,000.00 or more, each Bidder shall furnish with his bid price a "bid bond" (See Exhibit H) issued by a surety company licensed to issue bonds in the State of Maryland. The bond must be in an amount not less than five percent (5%) of the total amount of the base bid price and shall be in the form specified with the bid documents.

2. Certified checks, cash and other security in that amount are acceptable in lieu of a "bid bond", and shall be submitted with the Bid Price and subject to the same conditions as a bond.

3. Should the Bidder to whom the contract is awarded fail or be unable to execute the contract, for any reason, within ten (10) days after notification of award, then an amount equal to the difference between the accepted price, and that of the bidder to whom the award subsequently is made shall be paid to the University as liquidated damages.

4. The Bidder to whom a contract in excess of $100,000.00 is awarded also must furnish Performance and Payment Bonds (See Exhibits I and J), each in the amount of one hundred percent (100%) of the contract price, including executed Change Orders, in the form specified with the bid documents. These must be provided at the time of the signing of the contract and prior to the start of any work.

5. Bid Bonds remain in effect a minimum of ninety (90) days from the bid due date.

H. LICENSES AND QUALIFICATIONS
1. Construction contractors must be licensed as Md. Code Ann., Bus: Reg. § 17-601, and shall submit proof of current licensing with the bid.

2. The University reserves the right to require that a contractor demonstrate that it has the skills, equipment and other resources to satisfactorily perform the nature and magnitude of work necessary to complete the project within the proposed contract schedule.

I. BID DUE DATE
Bids must be received at the Issuing Office by date and time indicated on the Key Information Summary Sheet. Requests for extensions will not be granted. Late bids, late
requests for modification, or late requests for withdrawal will not be considered. Unless specifically requested, bids submitted by fax or other electronic devices will be rejected. It is recommended that bids be hand delivered.

J. OPENING OF BIDS
A public opening will be held at the date, time and location noted on the Key Information Summary Sheet.

K. DURATION OF BID OFFER
Bids submitted are irrevocable for 90 days after the bid due date. This period may be extended by mutual written agreement between the bidder and the University.

L. PROCUREMENT METHOD
This solicitation shall be conducted in accordance with the provisions of the University System of Maryland (USM) Procurement Policies and Procedures. The procurement method is Competitive Sealed Bidding.

M. AWARD
The University will recommend for award a responsive bid from the responsible bidder submitting the most favorable evaluated bid price for the requirement(s) herein.

N. MULTIPLE BID OR ALTERNATE BIDS
Unless multiple or alternate bids are specifically requested in the solicitation, they will not be accepted.

O. MINORITY BUSINESS ENTERPRISE UTILIZATION
An overall MBE subcontract participation goal of 29 percent of the total contract dollar amount has been established for this procurement. This percentage of the total dollar amount includes:

- A sub goal of 8 percent of the total contract dollar amount to be allocated to certified minority business enterprises classified as African-American-owned businesses.
- A sub goal of 3 percent of the total contract dollar amount to be allocated to certified minority business enterprises classified as Asian-owned businesses.
- A sub goal of 3 percent of the total contract dollar amount to be allocated to certified minority business enterprises classified as Hispanic-owned businesses.

By submitting a response to this solicitation, the bidder or offeror agrees that these percentages of the total dollar amounts of the contract will be performed by certified minority business enterprises as specified.

- A prime contractor — including an MBE prime contractor — must accomplish an amount of work not less than the MBE subcontract goal with certified MBE subcontractors.
- A prime contractor comprising a joint venture that includes MBE partner(s) must accomplish the MBE subcontract goal with certified MBE subcontractors.

Note: Per Exhibit E, Attachment 1A, when a certified MBE firm participates as a prime contractor on a Contract, a procurement agency may count the distinct, clearly-defined
portion of the work of the Contract that the certified MBE firm performs with its own workforce toward fulfilling up to, but no more than, fifty-percent (50%) of the overall MBE participation goal.

P. LIQUIDATED DAMAGES PROVISION RELATED TO MBE GOAL

This contract requires the Contractor to make good faith efforts to comply with the Minority Business Enterprise (“MBE”) Program and contract provisions. The University and the Contractor acknowledge and agree that the University will incur damages, including but not limited to, loss of goodwill, detrimental impact on economic development and diversion of internal staff resources if the Contractor does not make good faith efforts to comply with the requirements of the MBE Program and MBE contract provisions. The parties further acknowledge and agree that the damages the University might reasonably anticipate to accrue as a result of such lack of compliance are difficult to ascertain with precision.

Therefore, upon a determination by the University that the Contractor failed to make good faith efforts to comply with one or more of the specified MBE Program requirements or contract provisions, the Contractor agrees to pay liquidated damages to the University at the rates set forth below. The Contractor expressly agrees that the University may withhold payment on any invoices as a set-off against liquidated damages owed. The Contractor further agrees that for each specified violation, the agreed upon liquidated damages are reasonably proximate to the loss the University is anticipated to incur as a result of such violation.

a. Failure to submit each monthly payment report in full compliance with COMAR 21.11.03.13B (3): $24.93 per day until the monthly report is submitted as required.

b. Failure to include in its agreements with MBE subcontractors a provision requiring submission of payment reports in full compliance with COMAR 21.11.03.13B (4): $ 87.24 per MBE subcontractor.

c. Failure to comply with COMAR 21.11.03.12 in terminating, canceling, or changing the scope of work/value of a contract with an MBE subcontractor and/or amendment of the MBE participation schedule: the difference between the dollar value of the MBE participation commitment on the MBE participation schedule for that specific MBE firm and the dollar value of the work performed by that MBE firm for the contract.

d. Failure to meet the Contractor’s total MBE participation goal and sub-goal commitments: the difference between the dollar value of the total MBE participation commitment on the MBE participation schedule and the MBE participation actually achieved.

Notwithstanding the use of liquidated damages, the University reserves the right to terminate the contract and exercise all other rights and remedies provided in the contract or by law.

END OF SECTION I.
SECTION II. GENERAL INFORMATION FOR VENDORS

A. PURPOSE
The overall purpose of this solicitation is to provide information to vendors interested in preparing and submitting bids to meet the requirements herein. Bidders shall familiarize themselves with each section and subsection of this document.

B. REVISIONS TO IFB
1. The University reserves the right to amend this solicitation at any time prior to the bid due date. If it becomes necessary to amend any part of this solicitation, the procurement officer will furnish addenda to all prospective bidders known to have received a copy of this IFB.

2. Each bidder shall acknowledge the receipt of all addenda issued by completing Exhibit K, Addendum Acknowledgment Form, and enclosing it with the bid.

C. PRE-BID MODIFICATION OR WITHDRAWAL OF OFFERS
Bids may be modified or withdrawn by written notice received at the Issuing Office before the bid opening date and time.

D. CANCELLATION OF SOLICITATION/REJECTION OF ALL BIDS
The University reserves the right to cancel this IFB, to accept or reject any or all bids, in whole or in part, received in response to this IFB, and to waive or permit cure of minor irregularities as its best interests may require.

E. INCURRED EXPENSES
The University assumes no responsibility for expenses incurred in preparing and submitting bids in response to this solicitation.

F. ARREARAGES
By submitting a response to this solicitation, a bidder represents that it is not in arrears in the payment of any obligation due and owing the State of Maryland, including the payment of taxes and employee benefits, and that it shall not become so in arrears during the term of the contract if selected for contract award.

G. VERIFICATION OF REGISTRATION AND TAX PAYMENT
Each prospective bidder is encouraged to ensure that it is appropriately registered to do business in the State of Maryland, and in good standing with respect to taxes, personal property returns, unemployment insurance, etc., before the bid opening date. Failure to complete registration with the State Department of Assessments and Taxation (SDAT) may disqualify an otherwise successful bidder from recommendation for contract award.

H. ECONOMY OF PREPARATION
Bids should be prepared simply and economically, providing a straight-forward, concise description of the bidder's ability to fulfill the requirements of this solicitation.

I. PUBLIC INFORMATION ACT NOTICE
Bidder shall give specific attention to identification of those portions of its bid considered confidential, or containing proprietary information or trade secrets. Upon request, bidder shall provide justification why such material should not be disclosed by the University under the

J. EXECUTION OF BIDS

Bids shall be typewritten or written legibly in ink, and signed in ink as follows, depending on the bidder’s form of business organization:

1. **Sole Proprietorship.** Proprietor shall sign full name, with address.

2. **Partnership and Joint Venture.** Submit the bid/price proposal form in the name of the partnership or joint venture. Clearly state the partnership name and the identity of each general partner, and execute all affidavits and certificates on behalf of the partnership, or on behalf of each general partner. No provision of any agreement among partners will be binding on the University unless it is disclosed in the Bidder’s proposal. Reasonable evidence satisfactory to the University of the authority of one partner to bind other purported partners is required. Include a copy of the partnership agreement, if one exists. If no partnership agreement exists, and if the number of general partners is reasonably small, each general partner should execute all required documents. At the University’s option, all general partners may be required to sign. Failure to present the University with satisfactory information concerning a purported partnership or joint venture may be grounds for bid rejection.

3. **Corporation.** An officer or authorized agent of the corporation shall sign with full name, indicate title, and include the name and address of the corporation. In the case of an authorized agent, enclose a letter from an officer of the corporation authorizing said individual to act on behalf of the corporation.

K. DISCREPANCIES, EXPLANATIONS AND CLARIFICATIONS

Bidders finding discrepancies in the specifications or other provisions included in this solicitation, or in doubt as to the meaning or intent of any section or subsection herein, shall request clarification from the Procurement Officer. Failure to request clarification prior to the due date shall be a waiver of any claim by the Bidder for expenses made necessary by reason of later interpretation of the contract documents, and Bidder shall be bound to the University’s interpretation. Request clarifications in accordance with the instructions above.

L. ORDER OF PRECEDENCE

The contract to be entered into as a result of the IFB (the "Contract") will consist of the following contract documents listed in their order of precedence:

1. The contract executed by the parties and/or Purchase Order issued by the University;

2. The solicitation, Exhibit A-2 Required Contract Provisions for Construction/Maintenance, and all other Exhibits; and

3. The bid, as submitted by bidder and accepted by the University.

No modifications to this order of precedence will be accepted.

M. REQUIRED CONTRACT PROVISIONS

Bids submitted, and contract(s) executed with the successful bidder, are subject to Exhibit A and Exhibit A-1 (if applicable).
By submitting a bid, the vendor is deemed to have accepted the terms of this IFB, including exhibits; a bid that takes exception to the terms of the IFB may be rejected. Mutually agreeable modifications of the solicitation provisions, if allowed by law, will be documented by express identification in the final contract as superseding the pertinent provisions of the solicitation.

N. FALSE STATEMENTS
Bidders are advised that the Annotated Code of Maryland provides that in connection with a procurement contract, a person may not willfully: Falsify, conceal or suppress a material fact by any scheme or device; make a false or fraudulent statement or representation of a material fact; use a false writing or document that contains a false or fraudulent statement or entry of a material fact; or aid or conspire with another person to commit any of the aforementioned acts. A person who violates these provisions is guilty of a felony, and on conviction is subject to a fine not exceeding $20,000 or imprisonment not exceeding five (5) years, or both.

O. VENDOR ELECTRONIC FUNDS TRANSFER REGISTRATION
 Contractors of the State are required to complete a COT/GAD Form X-10, Vendor Electronic Funds Transfer (EFT) Registration Request Form, for each new contract with a value greater than $200,000. Vendors must register for EFT by submitting a completed COT/GAD Form X-10 to the Comptroller’s General Accounting Division (GAD) or request an exemption from GAD. The revised form is on the Comptroller’s Web site at http://compnet.comp.state.md.us/General_Accounting_Division/Vendors/Electronic_Funds_Transfer/default.shtml

P. RECIPROCAL PREFERENCE
While Maryland law does not authorize state agencies to favor resident bidders, other states grant preferences to their residents over Maryland businesses. Therefore, a resident business preference may be given to a Maryland firm if: A responsible bidder whose headquarters, principal base of operations, or principal site that will provide the services required by this IFB is located in another state submits the most advantageous offer; the other state gives a preference to its residents through law, policy, or practice; and the preference does not conflict with a Federal law or grant affecting the contract. The preference given shall be identical to the preference that the other state gives to its residents.

Q. NON-VISUAL ACCESS
The Contractor shall ensure compliance in any applicable contract with State of Maryland IT Non-Visual Access Standards. The standards should be incorporated to the fullest extent possible for information technology contracts. These standards/policies may be revised from time to time and the Contractor shall comply with all such revisions. The Non-visual Access Clause noted in COMAR 21.05.08.05 and referenced in the IFB is the basis for the standards that have been incorporated in the Maryland regulations.

R. PARKING
All vehicles parked on Towson University property must strictly observe University parking regulations. Each vehicle parked on campus between 6 am and 8 pm, Monday through Thursday, and from 6 am to 3 pm on Fridays, must display a valid University permit unless parked at a paid meter. Parking on sidewalks or unpaved areas is prohibited at all times. All fines for parking or other vehicle violations are the responsibility of the Contractor. This applies to vendors, salespersons, company vehicles, and Contractor employees’ personal vehicles. Long- and short-term permits are available, at designated rates, for vendors with...
contracts that require them to park regularly on the campus; see the parking website at http://www.towson.edu/parking/visitors/index.html for permit rates and information to support preparation of Bid/Price Proposal. Parking Transportation phone: (410) 704-7275. NOTE: INCLUDE PARKING FEES IN BID/PRICE PROPOSAL.

S. SMOKING

Smoking, defined as the burning of tobacco or any other material in any type of smoking equipment, including but not restricted to cigarettes, cigars or pipes, is prohibited on all property owned, leased or operated by the University. This consists of all buildings, including residence halls, leased restaurants and lodging facilities; all grounds, including exterior open spaces, parking lots and garages, on-campus sidewalks, streets, driveways, stadiums, recreational spaces and practice facilities; and in all University-owned or leased vehicles. The policy applies to all individuals on the University campus, including faculty, staff, students, parents, vendors and visitors. Contractor and its employees and subcontractors who violate the policy may be denied access to the University campus.

END OF SECTION II.
SECTION III. BID SUBMISSION REQUIREMENTS

A. ORGANIZATION OF BIDS

1. Bids must be submitted to the campus location of the Issuing Office not later than the date and time indicated on the Key Information Summary Sheet.

2. Submit one (1) clearly marked original and one (1) copy of each bid, in a sealed envelope. Indicate on the outside of the envelope the solicitation/ project number, bid due date, and bidder’s name and address.

3. If technical data, product literature, or brochures are needed to supplement the bid, enclose those materials after the last required form.

4. Bids that are incomplete or that deviate from the format required in this section may be rejected.

B. SUBMITTAL REQUIREMENTS CHECKLIST

Each bid must include the following:

1. **BID/PRICE PROPOSAL FORM**, typewritten or completed in ink and executed in accordance with the requirements in Section II. Each alteration to the Bid Form must be initialed, in ink, by the signatory.

2. **Exhibit B, BID/PROPOSAL AFFIDAVIT**, typewritten or completed in ink and executed in accordance with the requirements in Section II.

3. **Attachment 1A, from Exhibit E, MINORITY BUSINESS UTILIZATION PACKAGE.**

4. **Exhibit F, COMPANY PROFILE**

5. **Exhibit G, FIRM EXPERIENCE.** Duplicate as necessary to furnish references for no less than three (3) comparable projects completed within the past five (5) years, or currently underway.

6. **Exhibit H, BID BOND**

7. **Exhibit K, ADDENDA ACKNOWLEDGMENT FORM.** Should one or more addenda be issued, each bidder must acknowledge receipt using this form, identifying each addendum by number and date, and signing the document.

8. **Exhibit L, KEY PERSONNEL FORM.** Provide the names of key personnel to be assigned to this project, if awarded, and a brief resume on each, including educational background, work experience with bidder, previous work experience with other firms, and specific experience similar to the current project.

C. EVIDENCE OF BIDDER RESPONSIBILITY

The University may require any bidder to furnish additional information regarding past performance, financial capacity, technical expertise, or other qualifications bearing on performance of the contract, and reserves the right to consider any information otherwise
available, or to make such additional investigations as it deems necessary to confirm the responsibility of any bidder.

The Procurement Officer shall make purchases from, and award contracts, only to responsible contractors. In the absence of information clearly indicating that the prospective contractor is responsible, the Procurement Officer shall make a determination of non-responsibility.

END OF SECTION III.
SECTION IV. SCOPE OF WORK

Part 1. General

A. TU is seeking qualified contractors to provide Towson University with General Contractor services for new fit out for the first floor (former Bateman’s restaurant space) and reconfiguration and renovation of an existing suite on the second floor. The renovation project will include general construction renovation including electrical, HVAC, fire suppression, and upgrades to the electronic access control system and the telecom system currently in place.

B. The 7800 Building at Towson University is located in the southeast corner of campus at the corner of York Road and Cross Campus Drive.

C. Construction access to the 7800 Building can be made from York Road. In front of the 7800 Building for first floor work and in the rear of the building for the second floor work.

D. All work shall conform to all applicable codes and jurisdictional requirements as it relates to the construction of the offices, classrooms, MEP and life safety.

Part 2. Schedule

A. Construction shall start on or about April 3, 2019 and be completed prior to July 26, 2019.

B. General Contractor is responsible for determining lead time required for any items that require special order or are expected to have long lead times within the time constraints specified in Part II.

C. Contractor’s failure to meet this schedule will result in liquidated damages which will reduce the overall amount owed to the Contractor. Liquidated damages will be assessed as follows: $300 per day for each day the Contractors work on the project goes beyond July 26, 2019.

Part 3. References

A. All work accomplished under this contract shall be done in accordance with the current Towson University Design Guidelines and Construction Standards. The General Contractor is responsible for reviewing this document and determining what contents affect the proposed work. Where these documents are in conflict with best design and construction practices, confer with OFM for resolution.

B. Site Investigation – The General Contractor is responsible for thoroughly investigating the rooms and spaces to determine existing utility locations and existing conditions that are detrimental to the proposed work. General Contractor will contract with a private locator service to verify existing services in the area of construction as needed.
C. If any lead or asbestos containing materials are thought to be present, the General Contractor shall inform TUPM. TU OPS will furnish an abatement contractor if necessary.

Part 4. Scope of Services - Overview

A. General Contractor shall provide all necessary materials, equipment and services to complete required demolition and new construction of the offices and suite space and associated components in the timeframe indicated in the schedule (Part II) as depicted on construction drawings.

B. General Contractor is responsible for establishing all quantities and measurements to accomplish this work.

C. The proposed work under the contract includes, but is not limited to:

   a. All areas of work shall be sectioned off by the Contractor by means of barricades to prevent the general public from entering those zones during construction. ADA requirements to be followed. Provide appropriate signs as required by TU to direct general public around the construction site. The General Contractor is fully responsible for the ongoing safety of the public at all times. All work shall be accomplished while maintaining clean conditions at all times. When performing demolition (i.e. HVAC, Electrical and ceiling grid) that creates dust and dust migration, provide a negative air environment and portable HEPA filter equipment. Coordinate with the PM to close off HVAC or exhaust inlets during construction times.

   b. Coordinating construction activities with the Towson University Project Manager and with other university construction and activities scheduled during the same timeframe.

   c. Removing demolished materials immediately from the building to an acceptable steel container (roll off type) or vehicle provided by the contractor. Contractor vehicles used for demolition removal are not permitted to remain overnight on campus property. The Contractor shall maintain cleanliness around the container and vehicles at all times. The contents of the container shall not exceed the top surface of the container. All demolished materials shall be legally disposed of off campus. The Contractor shall provide protection for all floors and walls when transporting materials through the building.

   d. Constructing new partitions (with sound insulation) and vinyl cove base and all associated components (blocking / bracing) and paint all walls and door frames. The Contractor shall provide and install room number signs.

   e. Installing new ceiling grid, ceiling tile and lighting where required using university standards.

   f. Installing new carpet, doors and frames (see door styles on drawing) where required using university standards.
Providing electrical service and all necessary materials for items depicted on plans. The Contractor shall provide rough-in of telecommunications conduit and boxes. 1” conduit with neoprene bushings to above ceiling. See TU IT Standards Volume 1 document.

A/V cabling must be done by the A/V installer not through the GC. The Contractor must provide the following conduit per our standards: "in addition to the conduit for a quad electric outlet and 4 network drops, each floor box must have separate conduit for A/V signal and speaker, mic, camera cabling. Three 1” conduits or a 2” and a 1” conduit." The three 1” conduits or the 1” and 2” conduits must be dedicated to A/V only. The Contractor can just leave a pull string in this conduit for the A/V installer.

Data cabling shall be furnished and installed by the Contractor in accordance with TU Cabling Standards.

Access Control shall include Best IDH Max. Please refer to the Electronic Access Control specifications for all pertinent details.

All mechanical, electrical and plumbing (MEP) work shall be coordinated with TU Electrical and HVAC shops and installed in accordance with all applicable codes. Refer to MEP section of Construction Drawings and Specifications.

The Contractor shall provide the university with design / material submittals for acceptance. Submittals should include framing, all finishes, MEP, doors and hardware.

Part 5. Scope of Work – Electronic Access Control

5.1 General

A. The Contractor shall be responsible for expanding the current electronic access control system to provide additional access control capabilities to the 1st and 2nd floors of the 7800 York Road building.

B. Towson University currently uses a Lenel OnGuard Version 7.4 Access Control System. This version is current as of January 29, 2019.

C. Scope of Work:

a. Install a new access control head end in the building to support the locks being added. This will be a second head end collocated with the existing access control equipment in room YR 101.

b. Rewire several existing access control points to accommodate changes to existing conditions.

c. Furnish and install access control, integrated reader locksets as shown on the construction drawings.
d. Furnish and install access control devices and interfaces to support electrified locksets provided by others.

e. Coordinate work with other trades to provide a complete and functioning Lenel access control system.

f. The installing contractor shall:
   i. Be a Lenel Value Added Reseller.
   ii. Have in house design and engineering services.
   iii. Have the ability to develop AutoCAD drawings.

D. The design shall coordinate items in other sections of the GC’s scope. Finish Hardware to include electric strikes, electric latch retraction exit devices and delayed egress exit devices. There will be newly installed and existing to remain finish hardware in this scope. The Contractor shall include the interfacing, powering and configuration of these devices in the design of the access control system.

E. The Contractor shall submit shop drawings detailing the design phase of the project to for review and approval. At a minimum the shop drawings shall include:
   a. A riser diagram detailing the locations of the sub-panels within the facility and the connection of the system data ports and addressing scheme to those locations.
   b. Cabinet layouts depicting the interiors of cabinets with proposed port, address and device information.
   c. Wall layouts for cabinet and power supply installations in the IT closets. Drawing shall indicate locations of required power outlets.
   d. Schedule of Room, Cabinet, ISC Data Port, Address and Device identifier detailing the proposed assignment of devices and naming scheme for the installation.
   e. Low voltage power distribution schematic and schedule detailing the proposed power design. Schedule shall indicate the Power Supply Identifier, Output Number, Device Identifier and Designed Current Drain. Include designed load per power supply.

F. The Contractor shall provide submittal documents to the University electronically, in PDF format.

5.2 Materials

A. Access Control Electronics
a. All access control electronics used in this project shall be as manufactured by Lenel Systems International to be compatible with the University’s currently installed, campus-wide access control system. The following devices are approved by TU for use on this project. Not all items listed are necessarily required on this project.

1. Intelligent System Controller LNL-3300
2. Dual Reader Interface LNL-1320
3. Alarm Input Board LNL-1100
4. Alarm Output Board LNL-1200
5. Star Multiplexer LNL-8000
6. Magnetic Stripe Card Reader LNL-2005
7. Magnetic Swipe Card Reader with Keypad LNL-2020-NDK
8. Request to Exit Motion Detectors Bosch DS150i
9. Door Operator Interface Camden Model CX-33
10. Door Position Switch Interlogix 1078

b. The contractor may suggest substitutions to the above items. Contractor shall supply manufacturer’s data and specification documents for suggested replacements. Substitution requests must be submitted to TU prior to the deadline for questions indicated in the Key Information Summary Sheet.

B. Power Supplies

a. Power supplies used for access control electronics and electric strikes on this project shall be selected as required while meeting the following general provisions.

1. 12 vdc/24 vdc selectable output.
2. Filtered and electronically regulated output.
3. Shot circuit and thermal overload protection.
4. Built in charger for sealed lead acid or gel type battery backup. Appropriately sized and rated backup batteries shall be supplied with each power supply.
5. AC input and DC output LED indicators.
6. Fused or PTC power distribution integral to the supply for power to individual devices.

b. As a performance standard products manufactured by Altronix are acceptable. Alternative manufacturers’ products require submission to the owner for approval.

c. For electric latch retraction and delayed egress panic devices, the contractor shall supply power supplies manufactured by Allegion specific to the purpose. The contractor shall supply the Allegion PS-914 power supply with appropriate control modules to power the supplied hardware and meet the necessary Life Safety Codes.

C. Cable
a. All cable used for this project shall be plenum rated.

b. Composite cables shall be used for card reader installations where standalone readers, door contacts, request to exit and locking devices are installed. The composite cable shall be a manufactured assembly of individual cables each having a separate purpose to the installation. Each individual cable within the assembly shall have an overall shield, and be color coded and labeled for its purpose. As a performance standard the composite cable shall be Belden Cable #658AFJ. Alternate items shall be submitted to owner for approval.

c. Cable for individual credential readers shall be 8 conductor, 22 AWG with overall shield. As a performance standard the cable shall be Belden Cable #6506FE. Alternate items shall be submitted to owner for approval.

d. Cable for electric latch retraction exit devices and delayed egress exit devices shall be a minimum 4 conductor, 16 AWG, unshielded. Where required, cable gauge shall match manufacturer’s specifications for distance. As a minimum performance standard the cable shall be Belden Cable #6202UE. Alternate items shall be submitted to owner for approval.

D. Integrated Reader Locksets

a. To match existing conditions, the lockset shall be the IDH Max as manufactured by Best Access Systems.

b. The lockset shall be a mortise body lockset.

c. The lockset shall incorporate the Lenel LNL-1300 reader interface.

d. The lockset shall be prepped for a Best 7 pin Small Format Interchangeable Core.

E. Intrusion Motion Detectors

a. Shall be designed and listed for commercial applications

b. Shall be wall mounted.

c. Shall provide horizontal and vertical coverage patterns

d. Shall provide dual technology, microwave and passive infrared detection.

F. Audible Signal

a. Shall be wall mounted.

b. Shall produce no less than 100 dB signal level at 1 meter.

c. Shall be 12 or 24 volt dc operation.
d. Shall produce either a steady or warble tone.

5.3 Execution

A. Design

a. The contractor shall coordinate parts of this system provided in other sections of the project. Any discrepancies in materials or work performed by other trades shall be brought to owner’s attention upon discovery.

b. Contractor shall develop the architecture for the building’s access control, beginning at the Intelligent System Controller and accounting for the devices required and specified in this document.

c. Contractor shall develop the data distribution and addressing scheme for the access control system. The Contractor shall design the backbone cable distribution necessary to distribute the data between the main panel and sub-panel locations.

i. The design shall minimize the use of ISC data ports to allow for future expansion.

ii. Contractor shall supply schematic diagram for each special circuit required.

iii. Connection of specialized power supplies for exit devices and delayed egress exit devices.

d. Contractor shall determine the requirements for power supplies to support the access control electronics, electric strikes, electric latch retraction exit devices and delayed egress exit devices. The Contractor shall design the distribution of power.

i. The power for electronic boards shall be separated from the power for electrified locking devices.

ii. Power for each device shall be home run to the power distribution point and connected to individually fused or PTC protected terminals at the power supply.

iii. At each sub-panel location, an additional 30% capacity shall be designed for electronics boards and locksets to allow for future expansion.

e. Contractor shall develop and provide the submittal documents as defined Part A.

B. The arrangement for room YR 134Q shall be as follows:

a. The access control contractor shall furnish and install a Lenel LNL-2020-NDK card reader at the entrance to room YR 134Q.

b. The access control contractor shall power a Best Access Systems Electrified Mortise Lockset installed in the entry door to YR 134Q. This shall include all necessary cabling, raceways and connectors.
c. The access control contractor shall furnish and install two (2) motion
detectors within room YR 134Q. Final location of these detectors to be
determined by field conditions and final room configuration.

d. The access control contractor shall furnish and install one (1) door contact
on the entry door for room YR 134Q.

e. The access control contractor shall furnish and install one (1) audible signal
device inside room YR 134Q.

f. The motion detectors and door contact shall be connected to alarm inputs
in the Lenel system.

g. The electrified lockset shall be controlled by a relay output from the Lenel
system.

h. The audible signal device shall be controlled.

i. While the card reader will be connected to an LNL-1320 Dual Reader
Interface it will not directly control the lock or door position switch at this
location. In production, the card reader will be used to execute a local I/O
function list that will unlock the door and mask the door contact and motion
detectors.

C. Contractor is responsible beginning with the Intelligent System Controller. TU shall
supply the data connection for the ISC and the IP Address. Towson University
assigns IP addresses by DHCP based on address reservations. The contractor
shall supply TU the MAC address of the controller so the reservation request may
be made.

D. The Contractor shall furnish and install the access control electronics as
determined by the design.

E. The Contractor shall furnish and install the required power supplies as determined
by the design.

F. The Contractor shall furnish and install the required cabling to connect the
individual access control locations to the electronics as determined by the design.

G. The Contractor shall remove, rewire and reinstall existing locksets at rooms YR
128 and YR 129. Architectural scope for the GC will relocate the doors for these
two rooms. The locksets will remain connected to the existing access control head
end.

H. The Contractor shall remove, rewire and reinstall existing York Road Vestibule at
existing First Floor east facing door’s access point to control new exterior doors.
Additional cable and power supplies may be required. Access point will remain
connected to the existing access control head end.
I. The Contractor shall test the installation prior to connecting to the existing system. Testing requires that the contractor configure a database for the installation. This test database shall remain in place until the system is ready to be turned over to the University. The contractor shall demonstrate the function of each device in the system. The Contractor shall test the devices, as appropriate, for the following:

a. Access Granted/Denied  
b. Change Reader Mode  
c. Door Held Open  
d. Door Forced Open Restored  
e. Door Held Open Restored  
f. Alarm Active  
g. Alarm Cancelled  
h. Mask/Unmask Alarm Inputs  
i. Activate/Deactivate Alarm Outputs  

J. Upon completion of the installation, the contractor shall update the design documents to reflect as-built conditions. The contractor shall supply to the University a soft copy of the as-built documentation.

Part 6. Scope of Services-Telecom

6.1 General

As part of the renovation of the 1st and 2nd floor at its 7800 York Road building is seeking a contractor to:

A. Furnish, install, test, and label category 6 and category 6A data drops as shown on the construction drawings.

B. Physically mount University-provided wireless access points and connect it to the vendor-installed category 6A drop.

C. The contractor must coordinate all work with the University’s Office of Technology Services.

D. All materials and craftsmanship must conform to the Towson University IT Infrastructure Standards Volume 1, dated 1/8/2019, included as part of this bid package.

6.2 Materials

A. The University will provide the wireless access points.

B. The contractor must provide all other materials required to complete this scope of work.
C. The contractor must provide all equipment and tools necessary to complete the work, including but not limited to, ladders, crimpers, wire strippers, testers, labelers, etc.

6.3 Execution

A. The contractor must furnish and install data drops as shown on the construction drawings.

a. For drops designated for Wireless Access Points, the contractor must:
   i. Furnish and install one yellow Category 6A cable from each wireless access point location to the hub room on the same floor.
   ii. Leave a 15’ service loop at the end-station location.
   iii. Terminate the end-station location with an RJ45 connector.
   iv. Terminate the hub room end of the cable on a yellow category 6A jack and install the jack in a vendor-provided patch panel.
   v. Label both the end-station end and the hub room end.
   vi. Test the cable for category 6A compliance.
   vii. Physically mount a University-provided wireless access point and plug the wireless access point drop into the AP.

b. For drops designated for Security Cameras, the contractor must:
   i. Furnish and install one green Category 6 cable from each security camera location to the hub room on the same floor.
   ii. Leave a 15’ service loop at the end-station location.
   iii. Terminate the end-station location with an RJ45 connector.
   iv. Terminate the other end of the cable on a green category 6 jack and install the jack in a vendor-provided patch panel.
   v. Label both the end-station end and the hub room end.
   vi. Test the cable for category 6 compliance.

c. For all other data drops, the contractor must:
   i. Furnish and install one orange Category 6 cable from each general data drop location to the hub room on the same floor.
   ii. Terminate the end-station location with an orange jack and install the jack into a vendor-provided face plate.
   iii. Terminate the other end of the cable on an orange category 6 jack and install the jack in a vendor-provided patch panel.
   iv. Label both the end-station end and the hub room end.
   v. Test the cable for category 6 compliance.

B. Testing

a. The contractor must test and certify each newly installed cable for end-to-end compliance with the category of the cable, either category 6 or 6A.

C. Labeling

a. The installed cable must be labeled as specified in Towson University IT Infrastructure Standards.
b. The TR ID for the first floor is 1A.
c. The TR ID for the second floor is 2A.
d. The contractor must verify their understanding with Towson University prior to the start of labelling.

D. As-Built Documentation
   a. The contractor must provide an as-built spreadsheet that provides a map of each cable identifier and the room number in which the end-station is located.
   b. For drops in hallways, a short description referencing the nearest room or notable physical feature is acceptable for the end-station location.

6.4 Site Plans
   A. The construction documents are included in appendix Construction Drawings and Specifications in Part. 6.
   B. Hub room locations are marked Data Room on drawings.

6.5 Qualifications
   A. The installing contractor must have at least five (5) years’ experience in the telecommunications for the installation, termination, and testing of Category 6 and 6a cable.

6.6 Storage of Equipment/Materials and Trash Removal
   A. The contractor is responsible for the storage and security of their equipment and materials.
   B. The University may, on request of the contractor, provide space for storage. However, it cannot guarantee safety of equipment and materials.
   C. The contractor is responsible for providing all equipment needed to do the job, including ladders, lifts, and tools.
   D. The contractor is responsible for cleaning up after their work and must dispose of all trash off-site.

6.7 Safety
   A. The contractor shall supply, install, and maintain all barriers, protection, warning lights, lighting, and personnel required to segregate the work area(s) from pedestrian or vehicular traffic, as well as to prevent damage to buildings, their occupants, and the surrounding landscaped and paved areas. The Contractor shall observe all applicable OSHA and MOSHA requirements.
B. The contractor must wear identification or shirt with company logos.

Part 7. WARRANTY

A. General Contractor shall furnish the university with a minimum of a (2) two year warranty for all components upon substantial completion of all work.

B. The installing contractor(s) shall provide the University’s standard two-year warranty on labor.
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SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Phased construction.
4. Contractor's use of site and premises.
5. Coordination with occupants.
6. Work restrictions.
7. Specification and Drawing conventions.

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.2 PROJECT INFORMATION

A. Project Identification: Renovation – 7800 York Road, Towson University.

B. Architect: Whitman, Requardt & Associates, LLP.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

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

1. Renovation of the first-floor area previously occupied by Bill Bateman’s Restaurant to provide space for the Honors College, including modifications to associated mechanical and electrical systems located in the basement mechanical equipment room.
2. Infill of openings in the first floor slab and demolition of existing dumbwaiter to accommodate new first floor office and classroom layout.
3. Renovation of portions of the second floor to accommodate the Math and Computer sciences Department.
4. Other work indicated on Contract Documents.

B. Type of Contract:

1. Project will be constructed under a single prime contract.
1.4 CONTRACTOR'S USE OF SITE AND PREMISES

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

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

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

D. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.

1.5 COORDINATION WITH OCCUPANTS

A. Partial Owner Occupancy: Owner will occupy the premises during entire construction period, with the exception of areas under construction. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's operations. Maintain existing exits unless otherwise indicated.

1.6 WORK RESTRICTIONS

A. Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction.

B. On-Site Work Hours: Limit work in the existing building to normal business working hours of 7 a.m. to 5 p.m., Monday through Friday, unless otherwise indicated. Any hours outside of this period requires approval by the Owner.

C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:

1. Notify Owner not less than 7 days in advance of proposed utility interruptions.
2. Obtain Owner's written permission before proceeding with utility interruptions.

D. Noise, Vibration, Dust, and Odors: Coordinate operations that may result in high levels of noise and vibration, dust, odors, or other disruption to Owner occupancy with Owner.

1. Notify Owner not less than 7 days in advance of proposed disruptive operations.
2. Obtain Owner's written permission before proceeding with disruptive operations.
E. Smoking and Controlled Substance Restrictions: Use of tobacco products, alcoholic beverages, and other controlled substances on Owner's property is not permitted.

F. Employee Identification: Contractor personnel working on Project site must carry some form of identification and have shirts, hard hats, or vests with company name.

1.7 SPECIFICATION AND DRAWING CONVENTIONS

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

1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

2. Text Color: Text used in the Specifications, including units of measure, manufacturer and product names, and other text may appear in multiple colors or underlined as part of a hyperlink; no emphasis is implied by text with these characteristics.

3. Hypertext: Text used in the Specifications may contain hyperlinks. Hyperlinks may allow for access to linked information that is not residing in the Specifications. Unless otherwise indicated, linked information is not part of the Contract Documents.

4. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. Division 00 Contracting Requirements: General provisions of the Contract, including General and Supplementary Conditions, apply to all Sections of the Specifications.

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000
SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Owner will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.

1. Work Change Proposal Requests are not instructions either to stop work in progress or to execute the proposed change.
2. Within time specified in Proposal Request after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
   a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
   b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
   c. Include costs of labor and supervision directly attributable to the change.
   d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times,
and activity relationship. Use available total float before requesting an extension of the Contract Time.

1.3 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Work Change Proposal Request, Owner will issue a Change Order for signatures of Owner and Contractor.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600
SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.

1. Coordinate line items in the schedule of values with items required to be indicated as separate activities in Contractor's construction schedule.

2. Submit the schedule of values to Owner at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.

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

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

2. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.

3. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.

   a. Differentiate between items stored on-site and items stored off-site.

4. Overhead Costs: Include total cost and proportionate share of general overhead and profit for each line item.

5. Closeout Costs. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.

6. Schedule of Values Revisions: Revise the schedule of values when Change Orders or Construction Change Directives result in a change in the Contract Sum. Include at least one separate line item for each Change Order and Construction Change Directive.

1.3 APPLICATIONS FOR PAYMENT

A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified and paid for by Owner.
B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.

C. Payment Application Times: Submit Application for Payment to Owner by the 15 of the month. The period covered by each Application for Payment is one month, ending on the last day of the month.

D. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.

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

   1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
   2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
   3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.

F. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Owner by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.

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

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

   1. List of subcontractors.
   2. Schedule of values.
   3. Contractor's construction schedule (preliminary if not final).
   4. Schedule of unit prices.
   5. Submittal schedule (preliminary if not final).
   6. List of Contractor's staff assignments.
   7. List of Contractor's principal consultants.
   10. Initial progress report.

H. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

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

1. Evidence of completion of Project closeout requirements.
2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
3. Updated final statement, accounting for final changes to the Contract Sum.
5. AIA Document G706A.
6. Evidence that claims have been settled.
7. Final liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900
1.1 SUMMARY

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

1. General coordination procedures.
2. Coordination drawings.
3. RFIs.
4. Project meetings.

B. Related Requirements:

1. Section 017300 “Execution” for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.

1.2 INFORMATIONAL SUBMITTALS

A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:

1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.
3. Drawing number and detail references, as appropriate, covered by subcontract.

1.3 GENERAL COORDINATION PROCEDURES

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

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.
B. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Contractor's construction schedule.
2. Preparation of the schedule of values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.
8. Startup and adjustment of systems.

1.4 COORDINATION DRAWINGS

A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely indicated on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.

1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:

   a. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.

   b. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternative sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

B. Coordination Drawing Organization: Organize coordination drawings as follows:

1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.

2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within plenums to accommodate layout of light fixtures and other components indicated on Drawings. Indicate areas of conflict between light fixtures and other components.

3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.

4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.

5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door
floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.

6. Review: Architect will review coordination drawings to confirm that, in general, the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make suitable modifications and resubmit.

1.5 REQUEST FOR INFORMATION (RFI)

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

1. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

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

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

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

1. The following Contractor-generated RFIs will be returned without action:

   a. Requests for approval of submittals.
   b. Requests for approval of substitutions.
   c. Requests for approval of Contractor's means and methods.
   d. Requests for coordination information already indicated in the Contract Documents.
e. Requests for adjustments in the Contract Time or the Contract Sum.
f. Requests for interpretation of Architect's actions on submittals.
g. Incomplete RFIs or inaccurately prepared RFIs.

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

3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012600 "Contract Modification Procedures."

   a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Owner in writing within five days of receipt of the RFI response.

D. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly.

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

1.6 PROJECT MEETINGS

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

B. Preconstruction Conference: Owner will schedule and conduct a preconstruction conference before starting construction no later than 15 days after execution of the Agreement.

   1. Attendees: Authorized representatives of Owner Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.

C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity when required by other sections and when required for coordination with other construction.

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

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

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

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

4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.

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

D. Progress Meetings: Conduct progress meetings at biweekly intervals.

1. Coordinate dates of meetings with preparation of payment requests.

2. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.

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

   a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

      1) Review schedule for next period.

   b. Review present and future needs of each entity present, including the following:
1) Interface requirements.
2) Sequence of operations.
3) Status of submittals.
4) Deliveries.
5) Off-site fabrication.
6) Access.
7) Site use.
8) Temporary facilities and controls.
9) Progress cleaning.
10) Quality and work standards.
11) Status of correction of deficient items.
12) Field observations.
13) Status of RFIs.
14) Status of Proposal Requests.
15) Pending changes.
16) Status of Change Orders.
17) Pending claims and disputes.
18) Documentation of information for payment requests.

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

   a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100
SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

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

1. Contractor's Construction Schedule.
2. Construction schedule updating reports.
3. Daily construction reports.
4. Site condition reports.

1.2 DEFINITIONS

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

1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
2. Predecessor Activity: An activity that precedes another activity in the network.
3. Successor Activity: An activity that follows another activity in the network.

B. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.

C. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.

D. Event: The starting or ending point of an activity.

E. Float: The measure of leeway in starting and completing an activity.

1. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
2. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

1.3 INFORMATIONAL SUBMITTALS

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

1. PDF file.
B. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.

C. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.

D. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.
   1. Activity Report: List of activities sorted by activity number and then early start date, or actual start date if known.
   2. Logic Report: List of preceding and succeeding activities for each activity, sorted in ascending order by activity number and then by early start date, or actual start date if known.

E. Construction Schedule Updating Reports: Submit with Applications for Payment.

F. Daily Construction Reports: Submit at weekly intervals.

G. Site Condition Reports: Submit at time of discovery of differing conditions.

1.4 COORDINATION

A. Coordinate Contractor's Construction Schedule with the schedule of values, submittal schedule, progress reports, payment requests, and other required schedules and reports.
   1. Secure time commitments for performing critical elements of the Work from entities involved.
   2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

1.5 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

B. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Substantial Completion.
   1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

C. Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.

2. Procurement Activities: Include procurement process activities for long lead items and major items, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.


4. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.

5. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion.

D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.

1. Owner-Furnished Products: Include a separate activity for each product.

2. Work Restrictions: Show the effect of the following items on the schedule:
   a. Coordination with existing construction.
   b. Limitations of continued occupancies.
   c. Uninterruptible services.
   d. Use-of-premises restrictions.
   e. Seasonal variations.
   f. Environmental control.

E. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion.

F. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:

1. Unresolved issues.
2. Unanswered Requests for Information.
3. Rejected or unreturned submittals.
4. Notations on returned submittals.
5. Pending modifications affecting the Work and the Contract Time.

G. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.

1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
3. As the Work progresses, indicate final completion percentage for each activity.
H. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.

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

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

1.6 GANTT-CHART SCHEDULE REQUIREMENTS

A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's Construction Schedule within 15 days of date established for the Notice to Proceed.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.

1. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.

1.7 REPORTS

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

1. List of subcontractors at Project site.
2. Approximate count of personnel at Project site.
3. Equipment at Project site.
5. Testing and inspection.
6. Accidents.
7. Meetings and significant decisions.
8. Stoppages, delays, shortages, and losses.
10. Orders and requests of authorities having jurisdiction.
11. Change Orders received and implemented.
12. Change Directives received and implemented.
13. Services connected and disconnected.
14. Equipment or system tests and startups.
15. Substantial Completions authorized.

B. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for
Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013200
SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY
   A. Section Includes:
      1. Submittal schedule requirements.
      2. Administrative and procedural requirements for submittals.

1.2 DEFINITIONS
   A. Action Submittals: Written and graphic information and physical samples that require
      Architect's responsive action. Action submittals are those submittals indicated in individual
      Specification Sections as "action submittals."
   B. Informational Submittals: Written and graphic information and physical samples that do not
      require Architect's responsive action. Submittals may be rejected for not complying with
      requirements. Informational submittals are those submittals indicated in individual Specification
      Sections as "informational submittals."

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

1.4 SUBMITTAL FORMATS
   A. Submittal Information: Include the following information in each submittal:
      1. Project name.
      2. Date.
      4. Name of Contractor.
      5. Name of firm or entity that prepared submittal.
      6. Names of subcontractor, manufacturer, and supplier.
      7. Unique submittal number, including revision identifier. Include Specification Section
         number with sequential alphanumeric identifier; and alphanumeric suffix for
         resubmittals.
      8. Category and type of submittal.
10. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
11. Drawing number and detail references, as appropriate.
12. Indication of full or partial submittal.
13. Location(s) where product is to be installed, as appropriate.
14. Other necessary identification.
15. Remarks.
16. Signature of transmitter.

B. Options: Identify options requiring selection by Architect.

C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.

D. Electronic Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

1.5 SUBMITTAL PROCEDURES

A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Email: Prepare submittals as PDF package, and transmit to Owner by sending via email. Include PDF transmittal form. Include information in email subject line as requested by Owner.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.

C. Processing Time: Allow 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.

1. Initial Review: Allow 10 business 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.
2. Resubmittal Review: Allow 10 business days for review of each resubmittal.

D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

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

1.6 SUBMITTAL REQUIREMENTS

A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:
   a. Manufacturer's catalog cuts.
   b. Manufacturer's product specifications.
   c. Standard color charts.
   d. Statement of compliance with specified referenced standards.
   e. Testing by recognized testing agency.
   f. Application of testing agency labels and seals.
   g. Notation of coordination requirements.
   h. Availability and delivery time information.

4. For equipment, include the following in addition to the above, as applicable:
   a. Wiring diagrams that show factory-installed wiring.
   b. Printed performance curves.
   c. Clearances required to other construction, if not indicated on accompanying Shop Drawings.

5. Submit Product Data before Shop Drawings, and before or concurrent with Samples.

B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data unless submittal based on Architect's digital data drawing files is otherwise permitted.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
   a. Identification of products.
   b. Schedules.
   c. Compliance with specified standards.
   d. Notation of coordination requirements.
   e. Notation of dimensions established by field measurement.
   f. Relationship and attachment to adjoining construction clearly indicated.
   g. Seal and signature of professional engineer if specified.
C. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other materials.

1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.

2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
   a. Project name and submittal number.
   b. Generic description of Sample.
   c. Product name and name of manufacturer.
   d. Sample source.
   e. Number and title of applicable Specification Section.
   f. Specification paragraph number and generic name of each item.

3. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
   a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
   b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

4. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
   a. Number of Samples: Submit one full set of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.

5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
   a. Number of Samples: Submit three sets of Samples. Owner will retain two Sample sets; remainder will be returned.
      1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
      2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
D. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.

E. Certificates:

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

F. Test and Research Reports:

1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for substrate preparation and primers required.
2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
   a. Name of evaluation organization.
   b. Date of evaluation.
   c. Time period when report is in effect.
   d. Product and manufacturers' names.
   e. Description of product.
   f. Test procedures and results.
   g. Limitations of use.

1.7 DELEGATED-DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Architect.

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

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

1.8 CONTRACTOR'S REVIEW

A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.

B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

1. Architect will not review submittals received from Contractor that do not have Contractor's review and approval.

1.9 ARCHITECT'S REVIEW

A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required, and return it with appropriate action noted.

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

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

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

E. Architect will discard submittals received from sources other than Contractor.

F. Submittals not required by the Contract Documents will be returned by Architect without action.
PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013300
PART 1 - GENERAL

1.1 SUMMARY

A. Section includes special procedures for alteration work.

1.2 DEFINITIONS

A. Alteration Work: This term includes remodeling, renovation, repair, and maintenance work performed within existing spaces or on existing surfaces as part of the Project.

B. Consolidate: To strengthen loose or deteriorated materials in place.

C. Design Reference Sample: A sample that represents the Architect's prebid selection of work to be matched; it may be existing work or work specially produced for the Project.

D. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

E. Match: To blend with adjacent construction and manifest no apparent difference in material type, species, cut, form, detail, color, grain, texture, or finish; as approved by Architect.

F. Refinish: To remove existing finishes to base material and apply new finish to match original, or as otherwise indicated.

G. Repair: To correct damage and defects, retaining existing materials, features, and finishes. This includes patching, piecing-in, splicing, consolidating, or otherwise reinforcing or upgrading materials.

H. Replace: To remove, duplicate, and reinstall entire item with new material. The original item is the pattern for creating duplicates unless otherwise indicated.

I. Replicate: To reproduce in exact detail, materials, and finish unless otherwise indicated.

J. Reproduce: To fabricate a new item, accurate in detail to the original, and from either the same or a similar material as the original, unless otherwise indicated.

K. Retain: To keep existing items that are not to be removed or dismantled.

L. Strip: To remove existing finish down to base material unless otherwise indicated.
1.3 PROJECT MEETINGS FOR ALTERATION WORK

A. Preliminary Conference for Alteration Work: Before starting alteration work, conduct conference at Project site.

   1. Attendees: Owner and Contractor shall be represented at the meeting.
   2. Agenda: Discuss items of significance that could affect progress of alteration work, including review of the following:
      
      a. Fire-prevention plan.
      b. Governing regulations.
      c. Areas where existing construction is to remain and the required protection.
      d. Hauling routes.
      e. Sequence of alteration work operations.
      f. Storage, protection, and accounting for salvaged and specially fabricated items.
      g. Existing conditions, staging, and structural loading limitations of areas where materials are stored.

   3. Reporting: Record conference results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from conference.

1.4 INFORMATIONAL SUBMITTALS

A. Fire-Prevention Plan: Submit 15 days before work begins.

1.5 QUALITY ASSURANCE

A. Fire-Prevention Plan: Prepare a written plan for preventing fires during the Work, including placement of fire extinguishers, fire blankets, rag buckets, and other fire-control devices during each phase or process. Coordinate plan with Owner's fire-protection equipment and requirements. Include fire-watch personnel's training, duties, and authority to enforce fire safety.

B. Safety and Health Standard: Comply with ANSI/ASSE A10.6.

1.6 STORAGE AND HANDLING OF SALVAGED MATERIALS

A. Salvaged Materials for Reinstallation:

   1. Repair and clean items for reuse as indicated.
   2. Pack or crate items after cleaning and repairing; cushion against damage during handling. Label 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 unless otherwise indicated. Provide connections, supports, and miscellaneous materials to make items functional for use indicated.
B. Existing Materials to Remain: Protect construction indicated to remain against damage and soiling from construction work. Where permitted by Architect, items may be dismantled and taken to a suitable, protected storage location during construction work and reinstalled in their original locations after alteration and other construction work in the vicinity is complete.

PART 2 - PRODUCTS - (Not Used)

PART 3 - EXECUTION

3.1 PROTECTION

A. Protect persons, motor vehicles, surrounding surfaces of building, building site, plants, and surrounding buildings from harm resulting from alteration work.

1. Use only proven protection methods, appropriate to each area and surface being protected.
2. Provide temporary barricades, barriers, and directional signage to exclude the public from areas where alteration work is being performed.
3. Erect temporary barriers to form and maintain fire-egress routes.
4. Contain dust and debris generated by alteration work, and prevent it from reaching the public or adjacent surfaces.
5. Provide shoring, bracing, and supports as necessary. Do not overload structural elements.
6. Protect floors and other surfaces along hauling routes from damage, wear, and staining.

B. Temporary Protection of Materials to Remain:

1. Protect existing materials with temporary protections and construction. Do not remove existing materials unless otherwise indicated.
2. Do not attach temporary protection to existing surfaces except as indicated as part of the alteration work program.

C. Comply with each product manufacturer’s written instructions for protections and precautions. Protect against adverse effects of products and procedures on people and adjacent materials, components, and vegetation.

D. Utility and Communications Services:

1. Notify Owner, Architect, authorities having jurisdiction, and entities owning or controlling wires, conduits, pipes, and other services affected by alteration work before commencing operations.
2. Disconnect and cap pipes and services as required by authorities having jurisdiction, as required for alteration work.
3. Maintain existing services unless otherwise indicated; keep in service, and protect against damage during operations. Provide temporary services during interruptions to existing utilities.
3.2 PROTECTION FROM FIRE

A. General: Follow fire-prevention plan and the following:

1. Comply with NFPA 241 requirements unless otherwise indicated.
2. Remove and keep area free of combustibles, including rubbish, paper, waste, and chemicals, unless necessary for the immediate work.
   a. If combustible material cannot be removed, provide fire blankets to cover such materials.

B. Heat-Generating Equipment and Combustible Materials: Comply with the following procedures while performing work with heat-generating equipment or combustible materials, including welding, torch-cutting, soldering, brazing, removing paint with heat, or other operations where open flames or implements using high heat or combustible solvents and chemicals are anticipated:

1. Obtain Owner's approval for operations involving use of welding or other high-heat equipment. Use of open-flame equipment is not permitted. Notify Owner at least 72 hours before each occurrence, indicating location of such work.
2. As far as practicable, restrict heat-generating equipment to shop areas or outside the building.
3. Do not perform work with heat-generating equipment in or near rooms or in areas where flammable liquids or explosive vapors are present or thought to be present. Use a combustible gas indicator test to ensure that the area is safe.
4. Use fireproof baffles to prevent flames, sparks, hot gases, or other high-temperature material from reaching surrounding combustible material.
5. Prevent the spread of sparks and particles of hot metal through open windows, doors, holes, and cracks in floors, walls, ceilings, roofs, and other openings.
6. Fire Watch: Before working with heat-generating equipment or combustible materials, station personnel to serve as a fire watch at each location where such work is performed. Fire-watch personnel shall have the authority to enforce fire safety. Station fire watch according to NFPA 51B, NFPA 241, and as follows:
   a. Train each fire watch in the proper operation of fire-control equipment and alarms.
   b. Prohibit fire-watch personnel from other work that would be a distraction from fire-watch duties.
   c. Cease work with heat-generating equipment whenever fire-watch personnel are not present.
   d. Have fire-watch personnel perform final fire-safety inspection each day beginning no sooner than 30 minutes after conclusion of work to detect hidden or smoldering fires and to ensure that proper fire prevention is maintained.
   e. Maintain fire-watch personnel at Project site until 60 minutes after conclusion of daily work.

C. Fire-Control Devices: Provide and maintain fire extinguishers, fire blankets, and rag buckets for disposal of rags with combustible liquids. Maintain each as suitable for the type of fire risk in each work area. Ensure that nearby personnel and the fire-watch personnel are trained in fire-extinguisher and blanket use.
D. Sprinklers: Where sprinkler protection exists and is functional, maintain it without interruption while operations are being performed. If operations are performed close to sprinklers, shield them temporarily with guards.

1. Remove temporary guards at the end of work shifts, whenever operations are paused, and when nearby work is complete.

3.3 PROTECTION DURING APPLICATION OF CHEMICALS

A. Protect motor vehicles, surrounding surfaces of building, building site, plants, and surrounding buildings from harm or spillage resulting from applications of chemicals and adhesives.

B. Cover adjacent surfaces with protective materials that are proven to resist chemicals selected for Project unless chemicals being used will not damage adjacent surfaces as indicated in alteration work program. Use covering materials and masking agents that are waterproof and UV resistant and that will not stain or leave residue on surfaces to which they are applied. Apply protective materials according to manufacturer's written instructions. Do not apply liquid masking agents or adhesives to painted or porous surfaces. When no longer needed, promptly remove protective materials.

C. Neutralize alkaline and acid wastes and legally dispose of off Owner's property.

D. Collect and dispose of runoff from chemical operations by legal means and in a manner that prevents soil contamination, soil erosion, undermining of paving and foundations, damage to landscaping, or water penetration into building interior.

3.4 GENERAL ALTERATION WORK

A. Perform surveys of Project site as the Work progresses to detect hazards resulting from alterations.

B. Notify Architect of visible changes in the integrity of material or components whether from environmental causes including biological attack, UV degradation, freezing, or thawing or from structural defects including cracks, movement, or distortion.

1. Do not proceed with the work in question until directed by Architect.
SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

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

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

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

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

1.2 DEFINITIONS

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

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

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

   1. Use of trade-specific terminology in referring to a Work result does not require that certain construction activities specified apply exclusively to specific trade(s).

D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.

E. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST’s National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
F. Source Quality-Control Tests and Inspections: Tests and inspections that are performed at the source; for example, plant, mill, factory, or shop.

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

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

I. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor’s quality-control services do not include contract administration activities performed by Architect[ or Construction Manager].

1.3 DELEGATED-DESIGN SERVICES

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

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

B. Delegated-Design Services Statement: Submit a statement, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

1.4 CONFLICTING REQUIREMENTS

A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, inform the Architect regarding the conflict and obtain clarification prior to proceeding with the Work. Refer conflicting requirements that are different, but apparently equal, to Architect for clarification before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.
1.5 INFORMATIONAL SUBMITTALS

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

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

1.6 REPORTS AND DOCUMENTS

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

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

B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:

2. Statement that products at Project site comply with requirements.
3. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
4. Results of operational and other tests and a statement of whether observed performance complies with requirements.
5. Other required items indicated in individual Specification Sections.

C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:

1. Statement that equipment complies with requirements.
2. Results of operational and other tests and a statement of whether observed performance complies with requirements.
3. Other required items indicated in individual Specification Sections.

1.7 QUALITY ASSURANCE

A. Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.

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

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

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

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

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

G. Testing and Inspecting Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented according to ASTM E329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

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

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

1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspection they are engaged to perform.
2. Costs for retesting and reinspecting construction that replaces or is necessitated by Work that failed to comply with the Contract Documents will be charged to Contractor.

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

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

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


1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections and state in each report whether tested and inspected Work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform duties of Contractor.

E. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including
service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."

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

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

1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Preliminary design mix proposed for use for material mixes that require control by testing agency.
6. Security and protection for samples and for testing and inspection equipment at Project site.

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

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Architect.
4. Identification of testing agency or special inspector conducting test or inspection.

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

1. Submit log at Project closeout as part of Project Record Documents.
3.2 REPAIR AND PROTECTION

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

1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."

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

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

END OF SECTION 014000
SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

B. Related Requirements:
   1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.

1.2 USE CHARGES

A. Installation, removal, and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, Owner's, Architect, testing agencies, and authorities having jurisdiction.

B. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

C. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

1.3 INFORMATIONAL SUBMITTALS

A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.

B. Project Identification and Temporary Signs: Show fabrication and installation details, including plans, elevations, details, layouts, typestyles, graphic elements, and message content.

C. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.

D. Moisture- and Mold-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage and mold. Describe delivery, handling, storage, installation, and protection provisions for materials subject to water absorption or water damage.
1. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and requirements for replacing water-damaged Work.
2. Indicate sequencing of work that requires water and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
3. Indicate methods to be used to avoid trapping water in finished work.

1.4 QUALITY ASSURANCE

A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

C. Accessible Temporary Egress: Comply with applicable provisions in the United States Access Board's ADA-ABA Accessibility Guidelines.

1.5 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.

1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
2. Heating, Cooling, and Dehumidifying Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return-air grille in system and remove at end of construction.

C. Air-Filtration Units: Primary and secondary HEPA-filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.
PART 3 - EXECUTION

3.1 TEMPORARY FACILITIES, GENERAL

A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.

3.2 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.

B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.3 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service or connect to existing service.

1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.

C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.

D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

E. Temporary Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

1. Provide temporary dehumidification systems when required to reduce ambient and substrate moisture levels to level required to allow installation or application of finishes and their proper curing or drying.

F. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.

G. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
H. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.

3.4 SUPPORT FACILITIES INSTALLATION

A. Comply with the following:
   1. Utilize designated area within existing building for temporary field offices.
   2. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Traffic Controls: Comply with requirements of authorities having jurisdiction.
   1. Protect existing site improvements to remain including curbs, pavement, and utilities.
   2. Maintain access for fire-fighting equipment and access to fire hydrants.

C. Parking: Refer to Towson University Procurement documentation.

D. Storage and Staging: There will be limited space for staging area in front of Building 7800 for first floor work and limited space for staging behind the building for second floor and basement work.

E. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 017300 "Execution." Meet LEED BD+C requirements (75% recycling rate) for mixed construction materials. Provide a LEED report with materials and quantities at the conclusion of project.

F. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
   1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

G. Existing Elevator Use: Use of Owner's existing elevators will be permitted when scheduled with Owner, provided elevators are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore elevators to condition existing before initial use, including replacing worn cables, guide shoes, and similar items of limited life.
   1. Do not load elevators beyond their rated weight capacity.
   2. Provide protective coverings, barriers, devices, signs, or other procedures to protect elevator car and entrance doors and frame. If, despite such protection, elevators become damaged, engage elevator Installer to restore damaged work so no evidence remains of correction work. Return items that cannot be refinshed in field to the shop, make required repairs and refinish entire unit, or provide new units as required.

H. Existing Stair Usage: Use of Owner's existing stairs will be permitted, provided stairs are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore stairs to condition existing before initial use.
1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If stairs become damaged, restore damaged areas so no evidence remains of correction work.

3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.

1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.

B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

C. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each workday.

D. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

E. Temporary Egress: Provide temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction. Provide signage directing occupants to temporary egress.

F. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.

1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.

G. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner from fumes and noise.

1. Construct dustproof partitions with gypsum wallboard with joints taped on occupied side, and fire-retardant-treated plywood on construction operations side.

2. Where fire-resistance-rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.

3. Provide walk-off mats at each entrance through temporary partition.

H. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.
1. Prohibit smoking in construction areas. Comply with additional limits on smoking specified in other Sections.
2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
3. Develop and supervise an overall fire-prevention and protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.

3.6 MOISTURE AND MOLD CONTROL
A. Moisture and Mold Protection: Protect stored materials and installed Work in accordance with Moisture and Mold Protection Plan.

3.7 OPERATION, TERMINATION, AND REMOVAL
A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
B. Maintenance: Maintain facilities in good operating condition until removal.
   1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
C. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
   1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
   2. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 015000
SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 DEFINITIONS

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

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.

2. New Products: Items that have not previously been incorporated into another project or facility. Salvaged items or items reused from other projects are not considered new products. Items that are manufactured or fabricated to include recycled content materials are considered new products, unless indicated otherwise.

3. Comparable Product: Product by named manufacturer that is demonstrated and approved through the comparable product submittal process described in Part 2 "Comparable Products" Article, to have the indicated qualities related to type, function, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. Published attributes and characteristics of basis-of-design product establish salient characteristics of products.

1. Evaluation of Comparable Products: In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification. Manufacturer's published attributes and characteristics of basis-of-design product also establish salient characteristics of products for purposes of evaluating comparable products.

C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the
specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications; submit a comparable product request or substitution request, if applicable.

D. Comparable Product Request Submittal: An action submittal requesting consideration of a comparable product, including the following information:

1. Identification of basis-of-design product or fabrication or installation method to be replaced, including Specification Section number and title and Drawing numbers and titles.
2. Data indicating compliance with the requirements specified in Part 2 "Comparable Products" Article.

E. Basis-of-Design Product Specification Submittal: An action submittal complying with requirements in Section 013300 "Submittal Procedures."

1.3 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products, using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

1.5 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Written standard warranty form furnished by individual manufacturer for a particular product and issued in the name of the Owner or endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of the Owner or endorsed by manufacturer to Owner.

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

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

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
   1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
   2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
   3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
   4. Where products are accompanied by the term "as selected," Architect will make selection.

B. Product Selection Procedures:
   1. Sole Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
      a. Sole product may be indicated by the phrase "Subject to compliance with requirements, provide the following."
   2. Sole Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
      a. Sole manufacturer/source may be indicated by the phrase "Subject to compliance with requirements, provide products by the following."
   3. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements.
      a. Limited list of products may be indicated by the phrase "Subject to compliance with requirements, provide one of the following."
4. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed or an unnamed product that complies with requirements.
   a. Non-limited list of products is indicated by the phrase "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following."
   b. Provision of an unnamed product is not considered a substitution, if the product complies with requirements.

5. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
   a. Limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, provide products by one of the following."

6. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed or a product by an unnamed manufacturer that complies with requirements.
   a. Non-limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following."
   b. Provision of products of an unnamed manufacturer is not considered a substitution, if the product complies with requirements.

7. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications may additionally indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

   C. Visual Matching Specification: Where Specifications require the phrase "match Architect's sample," provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
   
   D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or a similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

PART 3 - EXECUTION (Not Used)
SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

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

1. Installation of the Work.
2. Cutting and patching.
3. Coordination of Owner’s portion of the Work.
4. Coordination of Owner-installed products.
5. Progress cleaning.
6. Starting and adjusting.
7. Protection of installed construction.

1.2 DEFINITIONS

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

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

1.3 QUALITY ASSURANCE

A. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.

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

2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.

3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.

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

B. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of specified products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Comply with requirements specified in other Sections.

1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with sustainable design requirements.

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

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

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

PART 3 - EXECUTION

3.1 EXAMINATION

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

1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

B. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
1. Description of the Work, including Specification Section number and paragraph, and Drawing sheet number and detail, where applicable.
2. List of detrimental conditions, including substrates.
3. List of unacceptable installation tolerances.
4. Recommended corrections.

C. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

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

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

C. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Owner in accordance with requirements in Section 013100 "Project Management and Coordination."

3.3 INSTALLATION

A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
   1. Make vertical work plumb, and make horizontal work level.
   2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
   3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
   4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces, unless otherwise indicated on Drawings.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure satisfactory results as judged by Architect. Maintain conditions required for product performance until Substantial Completion.

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

E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on-site and placement in permanent locations.
F. Tools and Equipment: Select tools or equipment that minimize production of excessive noise levels.

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

H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions with manufacturer.

   1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
   2. Allow for building movement, including thermal expansion and contraction.
   3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect, as judged by Architect. Fit exposed connections together to form hairline joints.

J. Repair or remove and replace damaged, defective, or nonconforming Work.

   1. Comply with Section 017700 "Closeout Procedures" for repairing or removing and replacing defective Work.

3.4 CUTTING AND PATCHING

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

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

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

C. Temporary Support: Provide temporary support of Work to be cut.

D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching in accordance with requirements in Section 011000 "Summary."

F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.

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

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.

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

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
   a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
   b. Restore damaged pipe covering to its original condition.
3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
   a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch, corner to corner of wall and edge to edge of ceiling. Provide additional coats until patch blends with adjacent surfaces.
4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.

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

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

3.5 PROGRESS CLEANING

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


2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F (27 deg C).

3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

   a. Use containers intended for holding waste materials of type to be stored.

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

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

   1. Remove liquid spills promptly.

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

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

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

F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 015000 "Temporary Facilities and Controls."

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

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

3.6 STARTING AND ADJUSTING

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

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

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

D. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

3.7 PROTECTION AND REPAIR OF INSTALLED CONSTRUCTION

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

B. Repair Work previously completed and subsequently damaged during construction period. Repair to like-new condition.

C. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.

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

END OF SECTION 017300
SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

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

1. Substantial Completion procedures.
2. Final completion procedures.
3. Warranties.
4. Final cleaning.

B. Related Requirements:

1. Section 017823 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
2. Section 017839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
3. Section 017900 "Demonstration and Training" for requirements to train the Owner's maintenance personnel to adjust, operate, and maintain products, equipment, and systems.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of cleaning agent.

B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.

C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.3 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

C. Field Report: For pest-control inspection.

1.4 SUBSTANTIAL COMPLETION PROCEDURES

A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's "punch list"), indicating the value of each item on the list and reasons why the Work is incomplete.
B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction, permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
2. Submit closeout submittals specified in other Division 01 Sections, including Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Owner. Label with manufacturer's name and model number.
5. Submit testing, adjusting, and balancing records.
6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Advise Owner of pending insurance changeover requirements.
2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
3. Complete startup and testing of systems and equipment.
4. Perform preventive maintenance on equipment used prior to Substantial Completion.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
6. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
7. Terminate and remove temporary facilities from Project site, along with construction tools, and similar elements.
8. Complete final cleaning requirements.
9. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.

D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Owner will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
1.5 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:

1. Submit a final Application for Payment in accordance with Section 012900 "Payment Procedures."
2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Owner. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.

B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Owner will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1.6 LIST OF INCOMPLETE ITEMS

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

1. Organize list of spaces in sequential order, listed by room or space number.
2. Organize items applying to each space by major element, including categories for ceilings, individual walls, floors, equipment, and building systems.
3. Include the following information at the top of each page:
   a. Project name.
   b. Date.
   c. Name of Architect.
   d. Name of Contractor.
   e. Page number.

4. Submit list of incomplete items in the following format:

1.7 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.
B. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.

C. Warranties in Paper Form:
   1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.

D. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

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

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
   a. Clean Project site of rubbish, waste material, litter, and other foreign substances.
   b. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
   c. Remove debris and surface dust from limited-access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
   d. Clean flooring, removing debris, dirt, and staining; clean according to manufacturer's recommendations.
   e. Vacuum and mop concrete.
   f. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
g. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.

h. Remove labels that are not permanent.

i. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.

j. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.

k. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.

l. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.

m. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.

n. Clean strainers.

o. Leave Project clean and ready for occupancy.

C. Construction Waste Disposal: Comply with waste-disposal requirements in Section 015000 "Temporary Facilities and Controls."

3.2 REPAIR OF THE WORK

A. Complete repair and restoration operations required by Section 017300 "Execution" before requesting inspection for determination of Substantial Completion.

END OF SECTION 017700
SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Operation and maintenance documentation directory manuals.
2. Systems and equipment operation manuals.
3. Systems and equipment maintenance manuals.
4. Product maintenance manuals.

1.2 CLOSEOUT SUBMITTALS

A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

1. Architect will comment on whether content of operation and maintenance submittals is acceptable.
2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

B. Format: Submit operation and maintenance manuals in the following format:

1. Submit on digital media acceptable to Owner. Enable reviewer comments on draft submittals.

C. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect will return copy with comments.

1. Correct or revise each manual to comply with Architect’s comments. Submit copies of each corrected manual within 15 days of receipt of Architect’s comments and prior to commencing demonstration and training.

D. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.3 FORMAT OF OPERATION AND MAINTENANCE MANUALS

A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.

2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

1.4 REQUIREMENTS FOR OPERATION, AND MAINTENANCE MANUALS

A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:

1. Title page.
2. Table of contents.

B. Title Page: Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Owner.
4. Date of submittal.
5. Name and contact information for Contractor.
6. Name and contact information for Construction Manager.
7. Name and contact information for Architect.
8. Name and contact information for Commissioning Authority.
9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
10. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."
1.5 SYSTEMS AND EQUIPMENT OPERATION MANUALS

A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.

B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

2. Performance and design criteria if Contractor has delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

C. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

D. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
F. Piped Systems: Diagram piping as installed, and identify color coding where required for identification.

1.6 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.

B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds, as described below.

C. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:

1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

   a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.

3. Identification and nomenclature of parts and components.

4. List of items recommended to be stocked as spare parts.

D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:

1. Test and inspection instructions.

2. Troubleshooting guide.

3. Precautions against improper maintenance.

4. Disassembly; component removal, repair, and replacement; and reassembly instructions.

5. Aligning, adjusting, and checking instructions.

6. Demonstration and training video recording, if available.

E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

H. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.

1.7 PRODUCT MAINTENANCE MANUALS

A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

C. Product Information: Include the following, as applicable:

1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
5. Reordering information for specially manufactured products.

D. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.
PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017823
SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:

1. Instruction in operation and maintenance of systems, subsystems, and equipment.
2. Demonstration and training video recordings.

1.2 INFORMATIONAL SUBMITTALS

A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.

1.3 QUALITY ASSURANCE

A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.

B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.

1.4 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by Architect.
1.5 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:

1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
   a. System, subsystem, and equipment descriptions.
   b. Performance and design criteria if Contractor is delegated design responsibility.
   c. Operating standards.
   d. Regulatory requirements.
   e. Equipment function.
   f. Operating characteristics.
   g. Limiting conditions.
   h. Performance curves.

2. Documentation: Review the following items in detail:
   a. Systems and equipment operation manuals.
   b. Systems and equipment maintenance manuals.
   c. Product maintenance manuals.
   d. Project Record Documents.
   e. Identification systems.
   f. Warranties and bonds.
   g. Maintenance service agreements and similar continuing commitments.

3. Emergencies: Include the following, as applicable:
   a. Instructions on meaning of warnings, trouble indications, and error messages.
   b. Instructions on stopping.
   c. Shutdown instructions for each type of emergency.
   d. Operating instructions for conditions outside of normal operating limits.
   e. Sequences for electric or electronic systems.
   f. Special operating instructions and procedures.

4. Operations: Include the following, as applicable:
   a. Startup procedures.
   b. Equipment or system break-in procedures.
   c. Routine and normal operating instructions.
   d. Regulation and control procedures.
   e. Control sequences.
   f. Safety procedures.
   g. Instructions on stopping.
   h. Normal shutdown instructions.
i. Operating procedures for emergencies.
j. Operating procedures for system, subsystem, or equipment failure.
k. Seasonal and weekend operating instructions.
l. Required sequences for electric or electronic systems.
m. Special operating instructions and procedures.

5. Adjustments: Include the following:
   a. Alignments.
   b. Checking adjustments.
   c. Noise and vibration adjustments.
   d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following:
   a. Diagnostic instructions.
   b. Test and inspection procedures.

7. Maintenance: Include the following:
   a. Inspection procedures.
   b. Types of cleaning agents to be used and methods of cleaning.
   c. List of cleaning agents and methods of cleaning detrimental to product.
   d. Procedures for routine cleaning.
   e. Procedures for preventive maintenance.
   f. Procedures for routine maintenance.
   g. Instruction on use of special tools.

8. Repairs: Include the following:
   a. Diagnosis instructions.
   b. Repair instructions.
   c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
   d. Instructions for identifying parts and components.
   e. Review of spare parts needed for operation and maintenance.

1.6 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017823 "Operation and Maintenance Data."

B. Set up instructional equipment at instruction location.
1.7 INSTRUCTION

A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.

B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

C. Scheduling: Provide instruction at mutually agreed-on times.
   1. Schedule training with Owner with at least seven days' advance notice.

D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.

PART 2 - PRODUCTS

PART 3 - EXECUTION

END OF SECTION 017900
SECTION 033053 - MISCELLANEOUS CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

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

1.2 SUMMARY
   A. Section includes cast-in-place concrete, including reinforcement, concrete materials, mixture design, placement procedures, and finishes.

1.3 ACTION SUBMITTALS
   A. Product Data: For each type of product.
   B. Design Mixtures: For each concrete mixture.

1.4 QUALITY ASSURANCE
   A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL
   A. Comply with the following sections of ACI 301 unless modified by requirements in the Contract Documents:
      1. "General Requirements."
      2. "Formwork and Formwork Accessories."
      3. "Reinforcement and Reinforcement Supports."
      4. "Concrete Mixtures."
      5. "Handling, Placing, and Constructing."
   B. Comply with ACI 117.
2.2 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.

B. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from as-drawn steel wire into flat sheets.


2.3 CONCRETE MATERIALS

A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

B. Cementitious Materials:

1. Portland Cement: ASTM C150/C150M, Type I/II.
2. Fly Ash: ASTM C618, Class C or F.
3. Slag Cement: ASTM C989/C989M, Grade 100 or 120.


D. Air-Entraining Admixture: ASTM C260/C260M.

E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
2. Retarding Admixture: ASTM C494/C494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.

F. Water: ASTM C94/C94M.

2.4 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.

B. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth or cotton mats.

C. Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.
D. Water: Potable.
E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C309, Type 1, Class B.

2.5 CONCRETE MIXTURES
A. Comply with ACI 301.
B. Normal-Weight Concrete:
   1. Minimum Compressive Strength: 3000 psi at 28 days.
   2. Maximum W/C Ratio: 0.50.
   3. Cementitious Materials: Use fly ash, pozzolan, slag cement, and blended hydraulic cement as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.
   4. Slump Limit: 4 inches 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.
   5. Air Content: Maintain within range permitted by ACI 301. Do not allow air content of trowel-finished floor slabs to exceed 3 percent.

2.6 CONCRETE MIXING
A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C94/C94M, and furnish batch ticket information.
   1. When air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C94/C94M. Mix concrete materials in appropriate drum-type batch machine mixer.
   1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
   2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd.
   3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mix type, mix time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 FORMWORK INSTALLATION
A. Design, construct, erect, brace, and maintain formwork according to ACI 301.
3.2 EMBEDDED ITEM INSTALLATION

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.3 STEEL REINFORCEMENT INSTALLATION

A. Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

   1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

3.4 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

3.5 CONCRETE PLACEMENT

A. Comply with ACI 301 for placing concrete.

B. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.

C. Do not add water to concrete during delivery, at Project site, or during placement.

D. Consolidate concrete with mechanical vibrating equipment according to ACI 301.

E. Equipment Bases and Foundations:

   1. Coordinate sizes and locations of concrete bases with actual equipment provided.
   2. Construct concrete bases 6 inches high unless otherwise indicated; and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated or unless required for seismic anchor support.
   3. Minimum Compressive Strength: 3000 psi at 28 days.
   4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
   5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base, and anchor them into structural concrete substrate.
   6. Prior to pouring concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   7. Cast anchor-bolt insert into bases. Install anchor bolts to elevations required for proper attachment to supported equipment.
3.6 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections exceeding 1/2 inch.

1. Apply to concrete surfaces

3.7 FINISHING UNFORMED SURFACES

A. General: Comply with ACI 302.1R for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Trowel Finish: Apply a hard trowel finish to surfaces indicated and to floor and slab surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin film-finish coating system.

3.8 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with ACI 305.1 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

D. Curing Methods: Cure formed and unformed concrete for at least seven days by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
   a. Water.
   b. Continuous water-fog spray.
   c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall
within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.9 FIELD QUALITY CONTROL

A. Tests: Perform according to ACI 301.

   1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
SECTION 053100 - STEEL DECKING

PART 1 - GENERAL

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

1.2 SUMMARY
   A. Section Includes:
      1. Composite floor deck.
   B. Related Requirements:
      1. Section 033053 "Miscellaneous Cast-in-Place Concrete" for normal-weight and lightweight structural concrete fill over steel deck.
      2. Section 055000 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.

1.3 ACTION SUBMITTALS
   A. Product Data: For each type of deck, accessory, and product indicated.
   B. Shop Drawings:
      1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.4 INFORMATIONAL SUBMITTALS
   A. Welding certificates.
   B. Product Certificates: For each type of steel deck.
   C. Product Test Reports: For tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
      1. Power-actuated mechanical fasteners.
      2. Acoustical roof deck.
   D. Evaluation Reports: For steel deck, from ICC-ES.
   E. Field quality-control reports.
1.5 QUALITY ASSURANCE
   A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.

1.6 DELIVERY, STORAGE, AND HANDLING
   A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
   B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS
   A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."
   B. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
      1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 COMPOSITE FLOOR DECK
   A. Composite Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:
      1. Galvanized-Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Grade 33, G60 zinc coating.
      2. Profile Depth:3 inches.
      3. Design Uncoated-Steel Thickness: 0.0358 inch.

2.3 ACCESSORIES
   A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.

D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

F. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.

G. Piercing Hanger Tabs: Piercing steel sheet hanger attachment devices for use with floor deck.

H. Galvanizing Repair Paint: ASTM A780/A780M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.

B. Install temporary shoring before placing deck panels if required to meet deflection limitations.

C. Locate deck bundles to prevent overloading of supporting members.

D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
H. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer’s written instructions.

3.3 FLOOR-DECK INSTALLATION

A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:

2. Weld Spacing: Weld edge ribs of panels at each support. Space additional welds an average of 12 inches apart, but not more than 18 inches apart.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of one-half of the span or 36 inches, and as follows:

1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:

1. End Joints: Lapped.

D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations unless otherwise indicated.

E. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

F. Install piercing hanger tabs at 14 inches apart in both directions, within 9 inches of walls at ends, and not more than 12 inches from walls at sides unless otherwise indicated.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Visually inspect all field welds.

C. Prepare test and inspection reports.

3.5 PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A780/A780M and manufacturer’s written instructions.
SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Steel framing and supports for mechanical and electrical equipment.
   2. Steel framing and supports for applications where framing and supports are not specified in other Sections.
   3. Slotted channel framing.

B. Products furnished, but not installed, under this Section include the following:
   1. Loose steel lintels.
   2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
   3. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

1.3 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:
   1. Fasteners.
   2. Slotted channel framing.
B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:

1. Steel framing and supports for mechanical and electrical equipment.
2. Steel framing and supports for applications where framing and supports are not specified in other Sections.
3. Loose steel lintels.

1.5 INFORMATIONAL SUBMITTALS

A. Mill Certificates: Signed by stainless steel manufacturers, certifying that products furnished comply with requirements.

B. Welding certificates.

C. Research Reports: For post-installed anchors.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls, floor slabs, decks, and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

C. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.

1. Size of Channels: 1-5/8 by 1-5/8 inches
2. Material: Cold-rolled steel, ASTM A1008/A1008M, structural steel, Grade 33 0.0677-inch minimum thickness coated with rust-inhibitive, baked-on, acrylic enamel.
2.2 FASTENERS

A. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 3, heavy-hex steel structural bolts; ASTM A563, Grade DH3, heavy-hex carbon-steel nuts; and where indicated, flat washers.

B. Anchors, General: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing in accordance with ASTM E488/E488M, conducted by a qualified independent testing agency.

C. Post-Installed Anchors: chemical anchors.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.


2.3 MISCELLANEOUS MATERIALS

A. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

2.4 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

F. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
2.5 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

1. Fabricate units from slotted channel framing where indicated.

2.6 GENERAL FINISH REQUIREMENTS

A. Finish metal fabrications after assembly.

B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.7 STEEL AND IRON FINISHES

A. Shop prime iron and steel items unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

1. Shop prime with universal shop primer indicated.

B. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."

C. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 INSTALLATION OF MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

B. Anchor supports securely to, and rigidly brace from, building structure.

END OF SECTION 055000
SECTION 210517 - SLEEVES AND SLEEVE SEALS FOR FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

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

1.2 SUMMARY
   A. Section Includes:
      1. Sleeves.
      2. Grout.

1.3 ACTION SUBMITTALS
   A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS
   A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 SLEEVES
   A. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop.
   B. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, galvanized, with plain ends and integral welded waterstop collar.
   C. Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.2 GROUT
   A. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint.

C. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."

3.2 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Concrete Slabs above Grade:
   a. Piping Smaller Than NPS 6: Steel pipe sleeves.

2. Interior Partitions:
   a. Piping Smaller Than NPS 6: Steel pipe sleeves.
   b. Piping NPS 6 and Larger: Galvanized-steel sheet sleeves.
SECTION 210518 - ESCUTCHEONS FOR FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

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

1.2 SUMMARY
   A. Section Includes:
      1. Escutcheons.
      2. Floor plates.

1.3 DEFINITIONS
   A. Existing Piping to Remain: Existing piping that is not to be removed and that is not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 ACTION SUBMITTALS
   A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS
   A. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.
   B. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed hinge; and spring-clip fasteners.

2.2 FLOOR PLATES
   A. Split Floor Plates: Steel with concealed hinge.
PART 3 - EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. Escutcheons for New Piping:
   a. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
   b. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
   c. Bare Piping in Unfinished Service Spaces: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
   d. Bare Piping in Equipment Rooms: One-piece steel with polished, chrome-plated finish.
   e. Bare Piping in Equipment Rooms: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.

2. Escutcheons for Existing Piping to Remain:
   a. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
   b. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
   c. Bare Piping in Unfinished Service Spaces: Split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
   d. Bare Piping in Equipment Rooms: Split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. New Piping: One-piece, floor plate.
2. Existing Piping: Split floor plate.

3.2 FIELD QUALITY CONTROL

A. Using new materials, replace broken and damaged escutcheons and floor plates.

END OF SECTION 210518
SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Pipes, fittings, and specialties.
   2. Sprinklers.

B. Related Requirements:
   1. Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping" for exposed-, flush-, and yard-type fire department connections.
   2. Section 210512 "Escutcheons for Fire-Suppression Piping" for ball, butterfly, check, gate, post-indicator, and trim and drain valves.

1.3 DEFINITIONS

A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175-psig maximum.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For wet-pipe sprinkler systems.
   1. Include plans, elevations, sections, and attachment details.
   2. Include diagrams for power, signal, and control wiring.

C. Delegated-Design Submittal: For wet-pipe sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer and professional engineer.

B. Design Data:

1. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

C. Welding certificates.

D. Field Test Reports:

1. Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."

2. Fire-hydrant flow test report.

E. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wet-pipe sprinkler systems and specialties to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

1.8 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

   a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.
B. Welding Qualifications: Qualify procedures and operators according to 2010 ASME Boiler and Pressure Vessel Code.

1.9 FIELD CONDITIONS

A. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler service according to requirements indicated:

1. Notify Owner no fewer than seven days in advance of proposed interruption of sprinkler service.
2. Do not proceed with interruption of sprinkler service without Owner's written permission.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:


B. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

C. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design wet-pipe sprinkler systems.

1. Available fire-hydrant flow test records indicate the following conditions:

   a. Date: 04/05/2002.
   b. Performed by: of BALTO. CITY DPW.
   c. Location of Flow Fire Hydrant F: CROSS CAMPUS DRIVE.
   d. Static Pressure at Residual Fire Hydrant R: 68 PSI.
   e. Measured Flow at Flow Fire Hydrant F: 2255 GPM.
   f. Residual Pressure at Residual Fire Hydrant R: 52 PSI.
   g. Available fire-hydrant flow test records are provided for information only. Contractor to perform updated fire-hydrant flow test to confirm available water supply is sufficient.

2. Sprinkler system design shall be approved by authorities having jurisdiction.

   a. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
   b. Sprinkler Occupancy Hazard Classifications:

      1) Building Service Areas: Ordinary Hazard, Group 1.
      2) Electrical Equipment Rooms: Ordinary Hazard, Group 1.
      3) General Storage Areas: Ordinary Hazard, Group 1.
4) Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
5) Office and Public Areas: Light Hazard.

3. Minimum Density for Automatic-Sprinkler Piping Design:
   a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
   b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
   c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area.

4. Maximum Protection Area per Sprinkler:
   a. Office Spaces: 225 sq. ft. (20.9 sq. m).
   b. Storage Areas: 130 sq. ft..
   c. Mechanical Equipment Rooms: 130 sq. ft..
   d. Electrical Equipment Rooms: 130 sq. ft..
   e. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.

2.2 STEEL PIPE AND FITTINGS

A. Standard-Weight, Black-Steel Pipe: ASTM A53/A53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.

B. Schedule 10, Black-Steel Pipe: ASTM A135 or ASTM A795, Schedule 10 in NPS 5 and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10, plain end.


D. Uncoated-Steel Couplings: ASTM A865/A865M, threaded.


F. Malleable- or Ductile-Iron Unions: UL 860.

G. Grooved-Joint, Steel-Pipe Appurtenances:
   1. Pressure Rating: 175-psig minimum.

2.3 SPRINKLER PIPING SPECIALTIES

A. Branch Outlet Fittings:
5. Type: Mechanical-tee and -cross fittings.
6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
8. Branch Outlets: Grooved, plain-end pipe, or threaded.

2.4 SPRINKLERS

A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
B. Pressure Rating for Automatic Sprinklers: 175-psig minimum.
C. Automatic Sprinklers with Heat-Responsive Element:
   1. Nonresidential Applications: UL 199.
   2. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.
E. Sprinkler Finishes: Chrome plated bronze and painted.
F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
   1. Ceiling Mounting: Chrome-plated steel, one piece, flat.
   2. Sidewall Mounting: Chrome-plated steel Plastic, white finish, one piece, flat.
G. Sprinkler Guards:
   2. Type: Wire cage with fastening device for attaching to sprinkler.

PART 3 - EXECUTION

3.1 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.
B. Report test results promptly and in writing.
3.2 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

B. Piping Standard: Comply with NFPA 13 requirements for installation of sprinkler piping.

C. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

D. Install unions adjacent to each valve in pipes NPS 2 and smaller.

E. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

G. Install sprinkler piping with drains for complete system drainage.

H. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

I. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.

J. Fill sprinkler system piping with water.

K. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

L. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

M. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 210518 "Escutcheons for Fire-Suppression Piping."

3.3 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
B. Install unions adjacent to each valve in pipes NPS 2 and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

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

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

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.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

G. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

H. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

3.4 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.

3.5 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

3.6 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
   2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
   3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.

B. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
C. Prepare test and inspection reports.

3.7 CLEANING

A. Clean dirt and debris from sprinklers.

B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

3.8 PIPING SCHEDULE

A. Standard-pressure, wet-pipe sprinkler system, shall be the following:
   1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.

B. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 to NPS 4, shall be the following:
   1. Schedule 10 black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

3.9 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:
   1. Rooms without Ceilings: Upright sprinklers.
   2. Rooms with Suspended Ceilings: Pendent, recessed, flush, and concealed sprinklers as indicated.
   4. Special Applications: Extended-coverage, flow-control, and quick-response sprinklers where indicated.

B. Provide sprinkler types in subparagraphs below with finishes indicated.
   1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
   2. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
   3. Upright Pendent and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view.

END OF SECTION 211313
SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division Specification Sections, as applicable, shall apply to this section.

B. References
   1. 2015 International Building Code
   2. 2015 International Mechanical Code
   3. 2015 National Standard Plumbing Code
   5. NFPA Standards
   6. ASHRAE Handbooks and Manuals
   7. SMACNA Manuals
   8. County Amendments

1.2 DEFINITIONS

A. "Piping" includes pipe, fittings, valves, hangers, and other accessories that comprise a system.

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

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

D. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

E. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

F. 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.

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

A. Regulatory Requirements
   1. Work shall conform to the requirements of the codes, laws and ordinances of Baltimore County, Maryland, National Fire Protection Association, American Society of Mechanical Engineers and other authorities having jurisdiction.
   2. Comply with applicable codes, laws, standard practices.

B. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

C. Give necessary notices and obtain required permits. Pay fees and other costs, including utility connections or extensions in connection with the work. File necessary plans, prepare documents and obtain necessary approvals of governmental agencies having jurisdiction. Obtain required certificates of inspection and deliver same to the Engineer before request for acceptance and final payment for the work.

D. Comply with the latest Towson University standards.

1.4 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 to prevent sagging and bending.

C. Proper and suitable tools, equipment and appliances for the safe and convenient handling and placing of materials and equipment shall be used. During loading, unloading, and placing, care shall be taken in handling the equipment and materials so that no equipment or materials, including Owner furnished, are damaged.

D. Mechanical equipment delivered to the job site shall be stored under roof or other approved covering, on pedestals above the ground. Enclosures for equipment shall be weatherproof. Any motors involved in the work that are not totally enclosed and electrical/electronic components shall be stored in a heated area with a minimum temperature of 50 deg. F. Valves shall be stored under roof on wood pedestals above ground. Pipe for project use shall be stored above grade in such a manner to prevent entrance of foreign materials. Pipe shall be fitted with end caps or seals to prevent moisture and debris from entering pipe. Insulation shall be store under roof or in trailers, adequately protected from the weather. Follow written instructions and recommendations of the manufacturer and requirements of the Engineer in lubrication, protection, and maintenance of equipment during storage.
E. If materials or equipment are found to be in poor condition at the time of being installed, the Engineer may, at his discretion, order the Contractor to furnish and install new equipment or materials at no cost to the Owner.

1.5 COORDINATION

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

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

C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

D. Coordinate new work and existing conditions. Modify, provide new or extend existing systems and equipment as necessary.

1.6 VARIANCES

A. Where conflicts exist within the contract documents, request clarification prior to the submission of a bid. If clarification is not requested, provide the work representing the higher cost and quality.

1.7 WARRANTY

A. Certain items of equipment shall be warranted for a longer time than the general warranty period. Provide for service or replacement required in connection with the warranty of these items.

B. See Division 1 and General Conditions for general requirements.

C. Provide service of the equipment manufacturer or his authorized representative, if required to achieve specified performance of equipment provided.

D. During the warranty period, service equipment provided. Provide labor and materials in accordance with manufacturer’s written instructions for service and maintenance. Prior to the start of warranty period, provide to the Engineer for approval, a schedule of required maintenance operations to be performed during the warranty period and required periodically thereafter for each system and item of equipment. Thereafter, monthly reports shall be submitted to the Owner for describing actual service performed. Forty-eight (48) hours advance notice shall be given to Owner prior to work required.

E. All equipment, labor and systems shall be guaranteed by the Contractor for period of two years minimum unless otherwise noted. Contractor shall be fully responsible for all repairs and adjustments to equipment and systems during this guaranty period.

F. Repairs and replacements: If the Owner finds work that is defective, inferior or not in compliance with the Contract during the guarantee period the Owner will inform the Contractor in writing. The Contractor shall promptly perform the following at no additional cost to the owner:
1. Replace all defective work in a satisfactory manner.
2. Correct all damage to the building or contents which occurred due to the defective work.

G. The Owner may choose to have defective work corrected at the expense of the Contractor if the Contractor fails to proceed promptly to repair defective work in an accordance with this guarantee.

1.8 MATERIALS AND WORKMANSHIP

A. Items shown and not specifically called for, or items specified and not specifically indicated or detailed on the Drawings, or items neither specified nor shown, but which are reasonably incidental to and commonly required shall be provided.

B. Furnish the services of an experienced full time field superintendent who shall be constantly in charge of the installation of work provided under this Division. Superintendent shall have demonstrated experience with projects of comparable size and complexity and shall be approved by the Engineer.

C. The quality of workmanship required in the execution of the work shall be the finest and highest obtainable, working with the materials specified. Workmanship shall be satisfactory to the Engineer and his decision as to acceptable quality is final.

1.9 EQUIPMENT START-UP AND INITIAL OPERATION

A. No equipment shall be operated for testing or trial use until there has been full compliance with the equipment manufacturers’ specifications and instructions for lubrication, alignment, direction of rotation, balance, and other applicable considerations.

B. Particular care shall be taken to verify that equipment is completely assembled and properly lubricated, and grease and oil cases and reservoirs have been filled to the correct level with the recommended lubricant.

C. Where specified, provide services of the manufacturer or his authorized representative to witness, supervise, or assist in the installation and start-up equipment provided under this Division.

1.10 DRAWINGS

A. The contract drawings are generally indicative of the work to be installed, but they do not show all offsets, fittings and similar details required, which shall be provided to meet the job conditions. In areas where work is installed in close proximity to work of other trades or within trades covered by this Division of the Specifications, prepare larger scale drawings consisting of plans and sections to show how work is to be installed in relation to work of other trades.

B. Before fabricating and installing the work, the Contractor shall call the condition to the attention of the Engineer for direction of any materials and/or equipment inaccessible or impractical. When requested by the Engineer a detailed drawing of the proposed departure due to field conditions, or their causes, shall be submitted by the Contractor for approval. The Engineer shall make final written decisions as to the conditions, which require the changing of work.
C. Contractor shall coordinate with the other trades prior to fabrication and installation. If coordination is found not to have occur (such as coordination drawings or meeting minutes), contractor(s) shall remove, relocate or modify at their costs.

1.11 RECORD DRAWING

A. See Division 1, for general requirements.

B. Carefully record the actual locations of each piece of concealed equipment, control devices, pipe, valves, ducts, terminal units, etc., including dimensions to locate underground work, and work when different from the contact drawings.

1.12 OPERATING AND MAINTENANCE INSTRUCTIONS

A. See Division 1 for general requirements of demonstration and training.

B. Upon completion of work and of tests, furnish the necessary skilled labor and helpers for operating and demonstrating the systems and equipment.

C. The instructor shall be thoroughly familiar with parts of the installation on which he is to give instruction and shall be trained in operating theory as well as practical operation and maintenance work. Employ factory trained instructors wherever necessary and as specified.

D. Instructions shall include a general description of each system together with specific instructions describing routine and emergency procedures required of the building personnel for operating and maintaining each system. The instructions shall include the name or label, location, and function of operating equipment and controls. Operating modes and the procedures for indexing each mode shall be clearly described. Include lubrication charts and schedules of frequency of lubrication for equipment, designating each point of lubrication and type of lubrication to be used. Listings of names, addresses, and phone numbers of the service organizations for each items of equipment and a typewritten maintenance schedule for same shall be included.

E. Provide operation and maintenance manuals and record product data as specified in Division 1. Submission for O&M shall allow time for the Engineer to review and comment.

1.13 DEMONSTRATION AND TRAINING DIGITAL VIDEO

A. Submit two DVD discs within seven days of end of each training module.

1. Identification: On each copy, provide an applied label with the following information:
   a. Name of Project.
   b. Name of Architect.
   c. Name of Contractor.
   d. Date video was recorded.
   e. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.

2. Transcript: Prepared on 8-1/2 by 11 inch paper, punched and bound in heavy-duty, 3-ring, vinyl-covered binders. Mark appropriate identification on front and spine of each binder.
Include a cover sheet with same label information as the corresponding videotape. Include name of Project and date of videotape on each page.

1.14 FIRE PREVENTION

A. As minimum, one five-pound CO₂ extinguisher shall be provided with each work crew.

1.15 SINGULAR NUMBER

A. See Division 1 for general requirements.

B. Where any device or part of equipment is herein referred to in the singular number, such as “value”, such reference applies to as many such devices as are required to complete the installation, shown or implied.

1.16 SUBMITTALS

A. Submittal review by the Engineer is intended to assist Contractor in his ability to comply with the Contract Documents. Review of submittal is only for general conformance with the design concept as given in Contract Documents. Where Contractor Submittals do not clearly indicate the intended materials for use, they may be returned without review or be rejected. Where differences between Contract Documents and Submittals are not noted, Contractor shall comply with requirements of Contract Documents. Contractor accepts all responsibility for quantities, dimensions, details, coordination of trades and job safety.

B. Definition:
   1. Action Submittals: Submit to Engineer for review.
   2. Informational Submittals: Provide submittals in Operational and Maintenance Manuals.

C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows.
   Time for review shall commence on Engineer’s receipt of submittal.
   1. Initial Review: Allow 20 working (business) days for initial review of each submittal. Allow Additional time if coordination with subsequent submittals is required. Engineer will advise Engineer when a submittal being processed must be delayed for coordination.
   2. Resubmittal review: Allow 15 working (business) days for each resubmittal.
   3. Engineer will review an initial submittal and one (1) resubmittal. Any additional reviews shall be billed to the General Contractor on an hourly basis at the Engineers current billing rates and will not be returned to the General Contractor until payment has been received. This shall not be cause for any delay claims or additional compensation claims by the General Contractor to the Owner.

PART 2 - PRODUCTS

2.1 PRODUCTS TO BE USED

A. Items are specified by designations such as trade name, manufacturer’s name, catalog number and indicate the capacity and quality of the products or materials to be used on this project.
B. Only products indicated on Contract Documents by name and model number have been coordinated with other trades and are the basis of design. Coordinate items of other manufacturer with other trades.

C. The work under this Section of the Specification shall include the furnishing of labor, materials and equipment for the installation of complete plumbing system to provide continuous and satisfactory service.

2.2 FIRESTOPPING

A. See additional information in section 078413.

B. System description
   1. Firestopping shall consist of furnishing and installing a material or combination of materials to form an effective barrier against the spread of flame, smoke, and gases, and maintain the integrity of fire resistance rate walls, barriers, partitions, floors, floor/ceiling/roof assemblies, including through penetrations and construction joints. Through-penetrations include the annular spaces around pipes, tubes, conduits, wires, cables, and vents. Construction joints include those used to accommodate expansion, contraction, wind, or seismic movement; firestopping materials shall not interfere with required movement of joints.

C. Storage and delivery
   1. Materials shall be delivered in the original un-opened packages or containers showing names of the manufacturer and the brand name of the product. Materials shall be stored off the ground and shall be protected from damage and exposure to elements. Damaged or deteriorated materials shall be removed from the site.

D. Firestopping materials
   1. Firestopping materials shall consist of commercially manufactured products complying with the following minimum requirements:
   2. Fire hazard classification: material shall have a flame spread of 25 or less, and a smoke developed rating or 50 or less, when tested in accordance with ASTM E 84 or UL 723. Materials shall be non-toxic to humans at all stages of the application and performance of the materials.
   3. Fire resistance rating: firestopping will not be required to have a greater fire resistance rating than that of the assembly in which it is being installed within. Fire resistance ratings of construction joints and gaps such as the construction in which they occur.

2.3 MOTOR STARTING EQUIPMENT

A. Unless otherwise specified, motor control centers, starters, disconnect switches and variable frequency controllers shall be provided by the Division 26 Contractor. Refer to Division 26 Sections for requirements.

2.4 DRIP PANS ABOVE ELECTRICAL OR ELECTRONIC EQUIPMENT

A. Do not route piping directly above electrical (or electronic) equipment; if not possible to avoid provide drip pans under, sufficient to protect electrical work from drips. Locate pan immediately
below piping, and extend a minimum of 6” on each side of piping and lengthwise 18” beyond the protected equipment. Fabricated pans of reinforced metal 2” deep, with rolled edges and soldered or welded seams; metal shall be 20 gage copper or 18 gage steel with 2 oz. zinc finish hot dipped after fabrication. Provide a minimum of 3/4” copper drainage piping, discharging to nearest floor drain, service sink, or as directed via air gap and per code.

2.5 PACKING MATERIAL FOR PENETRATIONS

A. Mineral fiber; non-combustible; resistant to water, mildew, and vermin. Expanding resilient foams manufactured for this purpose are an acceptable alternative only if the material density is at least 3.0 pounds per cubic foot.

PART 3 - EXECUTION

3.1 EXISTING CONDITIONS

A. Visit the site and become familiar with existing conditions. Modifications to work required to allow for existing conditions shall be provided. Submit proposed modifications to the Engineer for approval prior to installation.

B. Relocate existing hangers and supports where necessary to install new work. Maximum spacing requirements shall apply for relocated supports.

C. Coordinate interruptions in service of existing systems with the Owner. Provide temporary connections to maintain operation of existing systems.

D. Coordinate new work and existing conditions. Modify, provide new or extend existing systems and equipment as necessary.

E. Verify existing piping locations, sizes and inverts prior to any work or installation.

F. Disconnect, demolish, and remove plumbing 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 (valve and cap) or plug piping with same or compatible piping material.

3. Equipment to Be Removed: Disconnect and cap (valve and cap) services and remove equipment.

4. Equipment to Be Removed and Reinstalled: Disconnect and cap (valve 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 (valve and cap) services and remove equipment and deliver to Owner.

G. 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.
3.2 MANNER OF INSTALLATION

A. Piping shall be installed to preserve access to valves and equipment. Valves and equipment which require frequent service, adjustment or control and which cannot be located in a readily accessible and safe place, shall be provided with extension devices and remote operators, as necessary and as accepted for use by the Engineer.

B. Piping shall be run to follow the lines of the building and to allow the maximum headroom consistent with proper pitch. Piping subject to thermal expansion shall be arranged to permit movement without damage to the piping, ductwork and equipment.

3.3 EQUIPMENT CONNECTIONS

A. Equipment shall be installed and connected in accordance with the best engineering practice and in accordance with manufacturer’s instructions and recommendations. Auxiliary piping, valves, and electric connections recommended by the manufacturer or required for proper operation shall be provided.

3.4 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.

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

C. 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.

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

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

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

I. Install piping to allow application of insulation.

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

K. Install escutcheons for penetrations of walls, ceilings, and floors.

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

M. Permanent sleeves are not required for holes formed by removable PE sleeves.
N. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

O. 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.
   a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches 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 annular clear space between sleeve and pipe or pipe insulation to pass freely. Use the following sleeve materials:
   a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
   b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
   c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.

1) Seal space outside of sleeve fittings with grout.

P. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

Q. Verify final equipment locations for roughing-in.

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

3.5 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 22 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. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.6 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.

3.7 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.
3.8 PAINTING

A. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish. Provide complete new finish if, in the opinion of the Engineer or Owner, the factory finishes are severely damaged.
   1. Touch up threads of zinc coated screwed pipe with Rustoleum primer and one coat of enamel conforming to painting specification.
   2. Prepare piping and ductwork and associated hangers specified to be painted to accept field paint.

3.9 CUTTING AND PATCHING

A. See Division 1 for general requirements.

B. Cutting and patching of building materials shall be performed in a neat and workmanlike manner. Surfaces, which are damaged by the Contractor, shall be repaired or provided with new materials. Patching and materials shall be done with materials and methods similar to adjacent work, subject to approval of the Engineer. Structural members shall not be cut or penetrated unless indicated on the drawings.

3.10 SURVEYS AND MEASUREMENTS

A. Base measurements, both horizontal and vertical, from established benchmarks. Work shall agree with these established lines and levels. Verify measurements at site and check correctness of same as related to the work.

B. Should the Contractor discover any discrepancy between actual measurements or conditions, and those indicated which prevent following good practice or the intent of the drawings and specifications, he shall notify the Construction Manager and shall not proceed with his work until he has received instruction from the Construction Manager.

3.11 RIGGING OF EQUIPMENT

A. Verify that rigging path for equipment prior to start of work or ordering of materials. Verify accessways and weight carrying capacity of building features, including elevators, floors, walls, ceilings, roofs, and related features. When equipment or sections of equipment are larger than available accessways, equipment shall be ordered in a knocked-down configuration for re-assembly at the site. Submit in writing to Engineer where problems are encountered that may prohibit rigging of equipment into space with the proposed solutions.

B. Use planking or cribbing as required to protect adjoining construction from damage. Protect equipment from damage until construction is completed.

3.12 CLEANING

A. See Division 1, thoroughly clean exposed surfaces of equipment and material and leave in a neat, clean condition ready for painting.
3.13 ACCESSIBILITY

A. Locate equipment that must be serviced, operated or maintained, in fully accessible positions. Equipment shall include, but not be limited to, terminal units, coils, valves, motors, controllers, dampers, drain points, cleanouts, etc. Provide adequate means to access equipment for repair and maintenance including capabilities for platforms, fall protection systems, and anchorage points.

B. Where required or where directed, provide access doors. Doors installed in fire-rated walls or shafts shall be labeled and shall match rating of the construction. Doors shall be sufficient size to allow access to components, except minimum size shall be 16” x 16”. Access doors style shall be compatible with the finish surface it is attaching to. Access panels in ceilings for all plumbing and heating valves to be 24”x 24” minimum. No less than 16”x16” minimum for walls and other surfaces. Where equipment requires access to various parts, such as air terminal units require access to the controller and valve and piping appurtenances for the reheat coil, locate appurtenances requiring access such that all devices can be maintained from single door. For items that require access greater than 3 feet above the ceiling, provide minimum 4 feet x 4 feet removable ceiling panel to facilitate top of a folding ladder placed above the ceiling plane. Access doors are specified in Division 8.
   1. Manufacturers:
      a. Milcor, Inc.
      b. Cesco Products Company
      d. Zurn Industries

C. The Contractor at no expense to the Owner shall rework equipment deemed inaccessible by the Engineer.

3.14 TRAINING

A. Training shall be at a minimum noted below unless otherwise noted elsewhere.

B. Each demonstration session shall be recorded in DVD media format (video and audio format), including sessions below and added sessions required in technical sections for specialized equipment if equipment manufacturer has an in-house demonstration DVD’s for some equipment, submit copies before demonstrations, on-site filming of that equipment will not be required.
   1. Provide one complete set of DVDs arranged to be install in each O&M Manual(s).

END OF SECTION 220500
SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division Specification Sections, as applicable, shall apply to this section.

1.2 SUMMARY

A. Section Includes:
   1. Bronze ball valves.
   2. Bronze gate valves.

B. Related Sections:
   1. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. RS: Rising stem.

1.4 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:
   1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
   2. ASME B31.1 for power piping valves.
   3. ASME B31.9 for building services piping valves.

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

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
   1. Protect internal parts against rust and corrosion.
   2. Protect threads ends.

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

2.1 GENERAL REQUIREMENTS FOR VALVES
   A. Refer to valve schedule articles for applications of valves.
   B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
   C. Chain operators required on all valves 3” and over above 96” from finished floor.
   D. Butterfly valves may not be used on domestic water mains.
   E. Compression valves are not permitted on domestic water.
   F. Valves shall not be installed higher than 18” above ceiling.
   G. NIBCO valves are NOT allowed.
   H. Mechanical fittings such as groove or press fittings are NOT allowed.

2.2 BALL VALVES
   A. Whenever possible provide ball valves.
   B. Provide zone shut-off valves at all major branches of the piping system.
   C. Provide bleeder on ball valves ¾” or smaller.
   D. Isolation valves shall be provided for all equipment.
   E. Valve Sizes: Same as upstream piping unless otherwise indicated.
   F. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
      1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
   G. Valve-End Connections:
      1. Threaded: With threads according to ASME B1.20.1.
2.3 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Stainless Steel Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Crane Co.; Crane Valve Group; Stockham Division
   b. Apollo.
   c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:
   b. CWP Rating: 600 psig.
   c. Body Design: Two piece.
   d. Body Material: Bronze.
   e. Ends: Threaded.
   f. Seats: PTFE or TFE.
   g. Stem: Stainless Steel.
   h. Ball: Stainless Steel.
   i. Port: Full.

PART 3 - EXECUTION

3.1 EXAMINATION

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

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

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

D. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

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

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

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

D. Install valves in position to allow full stem movement.
3.3 ADJUSTING
   A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS
   A. If valve applications are not indicated, use the following:
      1. Shutoff Service: Ball valves.
      2. Throttling Service: Ball valves.

3.5 DOMESTIC, HOT-AND COLD-WATER VALVE SCHEDULE
   A. Pipe NPS 4 and Smaller:
      1. Ball Valves: Two piece, full port, bronze with bronze trim.

END OF SECTION 220523
SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division Specification Sections, as applicable, shall apply to this section.

1.2 SUMMARY

A. Section Includes:
   1. Metal pipe hangers and supports.
   2. Trapeze pipe hangers.
   3. Fiberglass pipe hangers.
   4. Metal framing systems.
   5. Fiberglass strut systems.
   6. Thermal-hanger shield inserts.
   7. Fastener systems.
   8. Pipe positioning systems.
   9. Equipment supports.

B. Related Sections:
   1. Division 22 Section "Vibration Controls for Plumbing Piping and Equipment".

C. The work under this Section of the Specification shall include the furnishing of labor, materials and equipment for the installation of complete hanger and supporting systems.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

   1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 INFORMATION SUBMITTALS

A. Operation and Maintenance Data: Provide hangers and supports submittals to include in operation and maintenance manuals

1.6 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:
   1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
   2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
   3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
   4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.

B. Stainless-Steel Pipe Hangers and Supports:
   1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
   2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.

C. Copper Pipe Hangers:
   1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
   2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel or stainless steel.
2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 FIBERGLASS PIPE HANGERS

A. Clevis-Type, Fiberglass Pipe Hangers:

1. Description: Similar to MSS SP-58, Type 1, steel pipe hanger except hanger is made of fiberglass or fiberglass-reinforced resin.

B. Strap-Type, Fiberglass Pipe Hangers:

1. Description: Similar to MSS SP-58, Type 9 or Type 10, steel pipe hanger except hanger is made of fiberglass-reinforced resin.
2. Hanger Rod and Fittings: Continuous-thread rod, washer, and nuts made of stainless steel.

2.4 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Allied Tube & Conduit.
   b. Cooper B-Line, Inc.
   c. Flex-Strut Inc.
   d. GS Metals Corp.
   e. Thomas & Betts Corporation.
   f. Unistrut Corporation; Tyco International, Ltd.
   g. Wesanco, Inc.

2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
4. Channels: Continuous slotted steel channel with inturned lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.

B. Non-MFMA Manufacturer Metal Framing Systems:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Anvil International; a subsidiary of Mueller Water Products Inc.
   b. Empire Industries, Inc.
   c. ERICO International Corporation.
   d. Haydon Corporation; H-Strut Division.
   e. NIBCO INC.
   f. PHD Manufacturing, Inc.
   g. PHS Industries, Inc.

2. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.


4. Channels: Continuous slotted steel channel with inturned lips.

5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.


2.5 FIBERGLASS STRUT SYSTEMS

A. Manufacturers: Subject to compliance with requirements available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Allied Tube & Conduit.
2. Champion Fiberglass, Inc.
3. Cooper B-Line, Inc.
4. SEASAFE, INC.; a Gibraltar Industries Company.

2.6 THERMAL-HANGER SHIELD INSERTS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Carpenter & Paterson, Inc.
3. ERICO International Corporation.
5. PHS Industries, Inc.
6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
7. Piping Technology & Products, Inc.
8. Rilco Manufacturing Co., Inc.
9. Value Engineered Products, Inc.

B. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig minimum compressive strength and vapor barrier.
C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig minimum compressive strength.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.7 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type, stainless-steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.8 PIPE POSITIONING SYSTEMS

A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.9 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.10 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and-packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
   2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Support items from truss top cord or kindorf/unistrut.
B. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

C. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers. No more than 1” of rod to hang below kindorf on trapeze hangers.
   1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
   2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

D. Fiberglass Pipe-Hanger Installation: Comply with applicable portions of MSS SP-69 and MSS SP-89. Install hangers and attachments as required to properly support piping from building structure.

E. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

F. Fiberglass Strut System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled fiberglass struts.

G. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

H. Fastener System Installation:
   1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
   2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

I. Pipe Stand Installation:
   1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
   2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Division 07 Section "Roof Accessories" for curbs.

J. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. See Division 22 plumbing fixture Sections for requirements for pipe positioning systems for plumbing fixtures.

K. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

M. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

N. Install lateral bracing with pipe hangers and supports to prevent swaying.

O. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

P. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

Q. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

R. Insulated Piping:

1. Attach clamps and spacers to piping.
   a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
   b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
   c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:
   a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
   b. NPS 4: 12 inches long and 0.06 inch thick.

5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
   1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

A. Additional hanger and support requirements are in Sections specifying piping systems and equipment.
1. Water piping: Provide Fee and Mason #212 split ring hangers with supporting rods.

2. Soil and waste piping:
   a. Provide Fee and Mason #212 adjustable ring hangers with supporting rods.
   b. Use Fee and Mason #241 riser clamps at each floor and as required

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers and metal framing systems and attachments for general service applications.

F. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.

G. Use padded hangers for piping that is subject to scratching.

H. Use thermal-hanger shield inserts for insulated piping and tubing.

I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.

14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.

15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.

16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.

17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.

18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.

19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.

20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.

21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.

2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.

2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.

3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.

4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.

5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.

2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
   a. Light (MSS Type 31): 750 lb.
   b. Medium (MSS Type 32): 1500 lb.
   c. Heavy (MSS Type 33): 3000 lb.
13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.

8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

   a. Horizontal (MSS Type 54): Mounted horizontally.
   b. Vertical (MSS Type 55): Mounted vertically.
   c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

O. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

P. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

Q. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

R. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529
SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division Specification Sections, as applicable, shall apply to this section.

1.2 SUMMARY
   A. Section Includes:
      1. Equipment labels.
      2. Pipe labels.
      3. Valve tags.

1.3 INFORMATIONAL SUBMITTALS
   A. Provide informational submittals in Operation and Maintenance Manuals in addition to action submittals and section 017823 “Operation and Maintenance Data”.
   B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label in the maintenance manuals.
   C. Valve numbering scheme and Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION
   A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
   B. Coordinate installation of identifying devices with locations of access panels and doors.
   C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS
   A. Metal Labels for Equipment for curved surfaces:
IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

1. Material and Thickness: anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
2. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
3. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
4. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
5. Fasteners: Moly-rivets.
6. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment’s Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch 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.

2.2 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction including arrows shall conform to ANSI A13.1 for both color and size of legend letters. Labels shall identify the piping system.

B. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

C. Pipe Label Contents: After piping has been installed, tested and insulated, include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Labels indicating direction of flow shall be applied adjacent to the name identification and shall point away from the name in the direction of flow.
2. Lettering Size: At least 2 inches high.
2.3 VALVE TAGS
   A. Valve Tags: Stamped 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
      1. Tag Material: Brass, 0.032-inch minimum thickness, 1.5 inch diameter with black filled numbers and having predrilled or stamped holes for attachment hardware.
      2. Fasteners: Tags shall be attached to valve wheels with a Brass wire-link.
   B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch 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.
      1. Valve-tag schedule shall be included in operation and maintenance data.

2.4 VALVE SCHEDULES
   A. Valve Schedules: For each piping system, on standard-size 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.
      1. Valve-Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include mounting screws.
      2. Frame: Extruded aluminum.
      3. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.

2.5 WARNING TAGS
   A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
      1. Size: 3 by 5-1/4 inches minimum.
      2. Fasteners: Brass grommet and wire.
      3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."

PART 3 - EXECUTION

3.1 GENERAL
   A. All valves and equipment to be identified by tags in addition by a plastic tag (Black letters on white background) mounted to the acoustical ceiling grid under the equipment.
   B. Ceiling identification tags shall be a laminated plastic with adhesive back, engraved black letters on white background, minimum .5 inch wide and length as required for .375 inch high
letters for name of concealed device and number. Ceiling identification tags are in addition to valve and equipment tags.

3.2 PREPARATION
A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.3 EQUIPMENT LABEL INSTALLATION
A. Install or permanently fasten labels on each major item of mechanical equipment.
B. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION
A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as plenums; and exterior exposed locations as follows:
   1. Near each valve and control device.
   2. Near each branch connection, excluding short takeoffs for fixtures. Where flow pattern is not obvious, mark each pipe at branch.
   3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
   4. At access doors, manholes, and similar access points that permit view of concealed piping.
   5. Near major equipment items and other points of origination and termination.
   7. On piping above removable acoustical ceilings.

3.5 VALVE-TAG INSTALLATION
A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

3.6 VALVE-SCHEDULE INSTALLATION
A. Mount valve schedule on wall in accessible location per Towson University Representative.
3.7 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

3.8 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.9 ADJUSTING

A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.10 CLEANING

A. Clean faces of mechanical identification devices.

END OF SECTION 220553
SECTION 220700 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division Specification Sections, as applicable, shall apply to this section.

1.2 SUMMARY

A. Section Includes:

1. Insulation Materials:
   a. Flexible elastomeric.
   b. Mineral fiber.
2. Adhesives.
3. Mastics.
4. Lagging adhesives.
5. Sealants.
6. Field-applied jackets.
7. Factory-applied jackets
8. Tapes.

B. Related Sections include the following:

1. Division 21 Section "Fire-Suppression Systems Insulation."
2. Division 23 Section "HVAC Insulation."

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets.

1.4 INFORMATIONAL SUBMITTALS

A. Provide informational submittals in Operation and Maintenance Manuals in addition to action submittals and section 017823 “Operation and Maintenance Data”.

B. Qualification Data: For qualified Installer.

C. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
D. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

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

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

1.6 DELIVERY, STORAGE, AND HANDLING

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

1.7 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

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

1.8 SCHEDULING

A. Schedule insulation application after pressure testing systems. Insulation application may begin on segments that have satisfactory test results.

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

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Aeroflex USA Inc.; Aerocel.
      b. Armacell LLC; AP Armaflex.
      c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.

G. Mineral-Fiber, Preformed Pipe Insulation:
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Johns Manville; Micro-Lok.
      b. Fibrex Insulations Inc.; Coreplus 1200.
      c. Knauf Insulation; 1000 Pipe Insulation.
      d. Manson Insulation Inc.; Alley-K.
      e. Owens Corning; Fiberglas Pipe Insulation.
   2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ or factory-applied ASJ-SSL.

2.2 INSULATING CEMENTS

A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Insulco, Division of MFS, Inc.; SmoothKote.
      c. Rock Wool Manufacturing Company; Delta One Shot.
2.3 ADHESIVES

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

B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Aeroflex USA Inc.; Aeroseal.
   b. Armacell LCC; 520 Adhesive.
   c. Foster Products Corporation, H. B. Fuller Company; 85-75.
   d. RBX Corporation; Rubatex Contact 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).

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Childers Products, Division of ITW; CP-82.
   c. ITW TACC, Division of Illinois Tool Works; S-90/80.
   d. Marathon Industries, Inc.; 225.
   e. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Dow Chemical Company (The); 739, Dow Silicone.
   d. Speedline Corporation; Speedline Vinyl 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).

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
1. For indoor applications, use mastics that have a VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24) or less.

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Childers Products, Division of ITW; CP-35.
   b. Foster Products Corporation, H. B. Fuller Company; 30-90.
   c. ITW TACC, Division of Illinois Tool Works; CB-50.
   d. Marathon Industries, Inc.; 590.
   e. Mon-Eco Industries, Inc.; 55-40.
   f. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.

3. Service Temperature Range: Minus 20 to plus 180 deg F.


C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Childers Products, Division of ITW; CP-30.
   b. Foster Products Corporation, H. B. Fuller Company; 30-35.
   c. ITW TACC, Division of Illinois Tool Works; CB-25.
   e. Mon-Eco Industries, Inc.; 55-10.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.

3. Service Temperature Range: 0 to 180 deg F.


D. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Childers Products, Division of ITW; CP-10.
   b. Foster Products Corporation, H. B. Fuller Company; 35-00.
   c. ITW TACC, Division of Illinois Tool Works; CB-05/15.
   e. Mon-Eco Industries, Inc.; 55-50.
   f. Vimasco Corporation; WC-1/WC-5.

2. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 200 deg F.
4. Solids Content: 63 percent by volume and 73 percent by weight.

2.5 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.

1. For indoor applications, use lagging adhesives that have a VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24) or less.
2. Products: Subject to compliance with requirements available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Foster Products Corporation, H. B. Fuller Company; 81-42.
   b. Childers Products, Division of ITW; CP-52.
   c. Marathon Industries, Inc.; 130.
   d. Mon-Eco Industries, Inc.; 11-30.
   e. Vimasco Corporation; 136.

3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over equipment and pipe insulation.
4. Service Temperature Range: Minus 50 to plus 180 deg F.

2.6 SEALANTS

A. Joint Sealants:

B. ASJ Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Childers Products, Division of ITW; CP-76.

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 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Childers Products, Division of ITW; CP-76.
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 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.7 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd..

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:


2.8 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Johns Manville; Zeston.
   c. Proto PVC Corporation; LoSmoke.
   d. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by jacket material manufacturer.
3. Color: Blue (Domestic cold, hot & recirculating water).
4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

   a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

2.9 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
   a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

2.10 TAPES
A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
      b. Compac Corp.: 104 and 105.
      c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
      d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
   2. Width: 3 inches.
   3. Thickness: 11.5 mils.
   5. Elongation: 2 percent.
   6. Tensile Strength: 40 lbf/inch in width.
   7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
B. PVC Tape: vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Avery Dennison Corporation, Specialty Tapes Division; Fasson
      b. Compac Corp.: 
      c. Ideal Tape Co., Inc., an American Biltrite Company; PVC tape.
      d. Venture Tape.
   2. Width: 2 inches
   3. Thickness: 6 mils
   5. Elongation: 500 percent.
   6. Tensile Strength: 18 lbf/inch in width.

2.11 SECUREMENTS
A. Bands:
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Childers Products; Bands.
   b. PABCO Metals Corporation; Bands.
   c. RPR Products, Inc.; Bands.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304; 0.015 inch thick, 1/2 inch wide with wing seal.

3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal.


2.12 CORNER ANGLES

A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. Color to match PVC field applied Jackets.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

1. Verify that systems and equipment to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.

B. Insulation exposed in areas with student access shall be wrapped with a metal jacket.

C. Install compressed fiberglass blocks (Wood blocks are NOT allowed) at hanger locations.
D. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.

E. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

F. Install insulation with longitudinal seams at top and bottom of horizontal runs.

G. Install multiple layers of insulation with longitudinal and end seams staggered.

H. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

I. Keep insulation materials dry during application and finishing.

J. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

K. Install insulation with least number of joints practical.

L. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

M. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

N. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
   a. For below ambient services, apply vapor-barrier mastic over staples.
4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

O. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

P. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

Q. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

R. For above ambient services, do not install insulation to the following:
   1. Vibration-control devices.
   2. Testing agency labels and stamps.
   3. Nameplates and data plates.

3.4 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
   1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
   2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
   3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
   4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
   5. Install handle extensions on valves which are insulated.
   6. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable
insulation cover. For below ambient services, provide a design that maintains vapor barrier.

7. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.

8. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.

9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.

2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.

3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.

4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.5 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:
   1. Install mitered sections of pipe insulation.
   2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:
   1. Install preformed valve covers manufactured of same material as pipe insulation when available.
   2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
   3. Install insulation to flanges as specified for flange insulation application.
   4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.6 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:
   1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
   2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
   3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
   4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:
   1. Install preformed pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
   3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
   4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:
   1. Install preformed sections of same material as straight segments of pipe insulation when available.
   2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
   3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
   4. Install insulation to flanges as specified for flange insulation application.

3.7 FIELD-APPLIED JACKET INSTALLATION
   A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
      1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
      2. Embed glass cloth between two 0.062-inch thick coats of lagging adhesive.
      3. Completely encapsulate insulation with coating, leaving no exposed insulation.
   B. PVC jackets shall be installed with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.
      1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

3.8 FIELD QUALITY CONTROL
   A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
   B. Perform tests and inspections.
   C. Tests and Inspections:
      1. Inspect field-insulated equipment, randomly selected by Engineer, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
      2. Inspect pipe, fittings, strainers, and valves, randomly selected by Engineer, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of fittings, three locations of valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.9 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
   1. Underground piping.
   2. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.10 INDOOR PIPING INSULATION SCHEDULE

A. General:
   1. New piping shall be insulated.

B. Domestic Cold Water:
   1. NPS 1 and Smaller: Insulation shall be one of the following:
      a. Flexible Elastomeric: 1 inch thick.
      b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
   2. NPS 1-1/4 and Larger: Insulation shall be one of the following:
      a. Flexible Elastomeric: 1 inch thick.
      b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

C. Domestic Hot and Recirculated Hot Water:
   1. NPS 1-1/4 and Smaller: Insulation shall be one of the following:
      a. Flexible Elastomeric: 1 inch thick.
      b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
   2. NPS 1-1/2 and Larger: Insulation shall be one of the following:
      a. Flexible Elastomeric: 1 inch thick.
      b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

3.11 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install PVC jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. Piping:
   1. PVC 30 mils thick.

END OF SECTION 220700
SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division Specification Sections, as applicable, shall apply to this section.

1.2 SUMMARY
A. Section Includes:
   1. Aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
   2. The work under this Section of the Specification shall include the furnishing of labor, materials and equipment for the installation of complete domestic water piping system to provide continuous and satisfactory service.

1.3 QUALITY ASSURANCE
A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
B. Comply with NSF 61 for potable domestic water piping and components. All valves and fittings are to be lead free.

1.4 PROJECT CONDITIONS
A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
   1. Notify Owner no fewer than 5 days in advance of proposed interruption of water service.
   2. Do not proceed with interruption of water service without Owner's written permission.
B. Notify Towson University at least 24 hours prior to pipe testing.

1.5 INFORMATIONAL SUBMITTALS
A. Provide informational submittals in Operation and Maintenance Manuals in addition to action submittals and section 017823 “Operation and Maintenance Data”.
C. Coordination Drawings: The Drawings are generally indicative of the work to be installed, but they do not show all offsets, fittings and similar details required, which shall be provided to
meet the job conditions. In areas where work is installed in close proximity to work of other trades or within trades covered by this Division of the Specifications, prepare larger scale drawings consisting of plans and sections to show how work is to be installed in relation to work of other trades.

D. Field quality-control reports.

E. System purging and disinfecting activities report.

F. Field quality-control reports.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

B. Potable-water piping and components shall comply with NSF 61.

C. Provide for expansion of piping subject to temperature changes. This shall be accomplished by swings, bends or loops.

D. Galvanized, CVPC or PVC piping are NOT allowed.

E. Mechanical fitting such as groove or press fitting are NOT allowed.

F. See piping schedule in paragraph 3.9 for additional information.

2.2 TRANSITION FITTINGS

A. General Requirements:
   1. Same size as pipes to be joined.
   2. Pressure rating at least equal to pipes to be joined.
   3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

2.3 DIELECTRIC FITTINGS

A. No dielectric unions are allowed.
PART 3 - EXECUTION

3.1 PIPING INSTALLATION

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

B. Install domestic water piping level and plumb.

C. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

E. Install piping adjacent to equipment and specialties to allow service and maintenance.

F. Install piping to permit valve servicing.

G. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.

H. Install piping free of sags and bends.

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

J. Install unions in copper tubing at final connection to each piece of equipment and specialty.

3.2 JOINT CONSTRUCTION

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

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.3 VALVE INSTALLATION

A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations.

B. Compression valves are not permitted on domestic water.
C. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping NPS 2 and smaller.

D. Install drain valves for equipment at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 22 Section "Domestic Water Piping Specialties."

1. Hose-End Drain Valves: At low points in branches and low points of system.
2. Caps and chains on all hose connections.

3.4 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

3.5 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping adjacent to equipment allow space for service and maintenance.

C. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping with shutoff valve; extend and connect to the following:
   1. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Piping Inspections:
   1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
   2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
      a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
      b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified in “Piping Tests” Subparagraph below and to ensure compliance with requirements.
   3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

C. Piping Tests:

1. Notify Towson University at least 24 hours prior to pipe testing.
2. Before testing piping systems, remove or otherwise protect from damage, control devices, air vents, plumbing fixtures and other parts which are not designed to stand pressures used in testing piping.
3. Domestic water piping shall be tested hydrostatically. Check components to determine that they are not air bound and that piping is full of water.
4. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
5. Provide water pipe test results.
6. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
7. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
8. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
9. Prepare reports for tests and for corrective action required.

D. Domestic water piping will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.7 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
5. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.8 CLEANING AND DISINFECT

A. Clean and disinfect domestic water piping as follows:

1. Purge all new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Chemicals and materials used for sterilization of the systems shall meet the requirements of the authorities having jurisdiction.
3. Use purging and disinfecting procedures prescribed by authorities having jurisdiction, local codes or the health department; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:

a. Flush piping system with clean, potable water until dirty water does not appear at outlets.

b. Fill and isolate system according to either of the following:

1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.

2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.

d. Obtain representative samples of the systems water for analysis by a recognized bacteriological laboratory. Submit water samples in sterile bottles to authorities having jurisdiction.

e. Repeat procedures if biological examination shows contamination. Repeat until the samples are acceptable.

B. As a condition of acceptance of the system, furnish a certificate under seal to certify that the system has been sterilized to meet the requirements of the Health Department and that the system is satisfactory for human consumption.

C. Prepare and submit reports of purging and disinfecting activities. Include copies of water sample approvals from authorities having jurisdiction.

D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.9 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Fitting Option: brazed joints may be used on aboveground copper tubing.

D. No Galvanized, PVC or CPVC allowed on domestic water piping.

E. Mechanical fitting such as groove or press fitting are NOT allowed

F. Aboveground domestic water piping, NPS 4 and smaller, shall be the following:
   1. Hard copper tube, ASTM B 88, Type L plain end, copper solder-joint fittings; and brazed/soldered joints.
3.10 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

2. Throttling Duty: Use ball valves for piping NPS 4 and smaller.
3. Hot-Water Circulation Piping, Balancing Duty: Calibrated (under 2”) and Memory-stop (2” and over) balancing valves.

END OF SECTION 221116
Contractor _____________________________________________

**PIPING TEST CERTIFICATE**

**Project** ____________________________________________  **Project Number** __________________________

**Location** ____________________________________________

<table>
<thead>
<tr>
<th>System Tested</th>
<th>Pipe Material</th>
<th>Pipe Installation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic Water</td>
<td>Copper</td>
<td>Solder</td>
</tr>
<tr>
<td>Sanitary &amp; Vent</td>
<td>Cast Iron &amp; Spigot</td>
<td>Welded</td>
</tr>
<tr>
<td>Storm Water</td>
<td>Cast Iron No-Hub</td>
<td>Threaded</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>Galvanized Steel</td>
<td>Grooved</td>
</tr>
<tr>
<td>Hot Water Heating</td>
<td>Schd. 40 Steel</td>
<td>Mechanical Joint</td>
</tr>
<tr>
<td>Chilled Water</td>
<td>Schd. 80 Steel</td>
<td>Lead &amp; Oakum</td>
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<tr>
<td>Stream &amp; Condensate</td>
<td>Ductile Iron</td>
<td>Neoprene Gasket</td>
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<tr>
<td>Fuel Lines</td>
<td>P.V.C.</td>
<td>No-Hub Clamp</td>
</tr>
<tr>
<td>Other:</td>
<td>Other:</td>
<td>Other:</td>
</tr>
</tbody>
</table>

**Type of Test**

| Hydrostatic | Air   | Gravity Head |

**TEST PRESSURE**

1<sup>ST</sup> Hour_________ 2<sup>nd</sup> Hour____________ 3<sup>rd</sup> Hour____________ 4<sup>th</sup> Hour____________

Leaks________________________________________________________

_________________________________  _____________________
Contractor                        Inspector

**Note:** ___________________________________________________
SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division Specification Sections, as applicable, shall apply to this section.

1.2 SUMMARY

A. This Section includes the following domestic water piping specialties:
   1. Balancing Valves
   2. Water hammer arresters.
   3. Access Boxes
   4. Building Water Meter

B. The work under this Section of the Specification shall include the furnishing of labor, materials and equipment for the installation of complete domestic water system to provide continuous and satisfactory service.

1.3 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.
   1. Water Hammer arrestors

1.5 INFORMATIONAL SUBMITTALS

A. Provide informational submittals in Operation and Maintenance Manuals in addition to action submittals and section 017823 “Operation and Maintenance Data”.

B. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water piping specialties to include in operation, and maintenance manuals.
1.7 QUALITY ASSURANCE

A. NSF Compliance:
   1. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

A. Potable-water piping and components shall comply with NSF 61.

2.2 BALANCING VALVES

A. Memory-Stop Balancing Valves
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Crane Co.; Crane Valve Group; Jenkins Valves.
      b. Crane Co.; Crane Valve Group; Stockham Div.
      c. NIBCO INC.
   2. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
   3. Pressure Rating: 400-psig minimum CWP.
   4. Size: NPS 2 or smaller.
   5. Body: Copper alloy.
   6. Port: Standard or full port.
   7. Ball: Chrome-plated brass.
   8. Seats and Seals: Replaceable.
   9. End Connections: Solder joint or threaded.
      Handle: Vinyl-covered steel with memory-setting device.

2.3 WATER HAMMER ARRESTERS

A. Water Hammer Arresters:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. AMTROL, Inc.
      b. Josam Company.
      c. MIFAB, Inc.
      d. PPP Precision Plumbing Products, Inc.
      e. Sioux Chief Manufacturing Company, Inc.
g. Tyler Pipe; Wade Div.
h. Watts Drainage Products Inc.
i. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Operation Products.

4. Type: Metal bellows.
5. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.4 ACCESS BOXES

A. Walls: Provide Jay R. Smith #4730 or Josam #8650 with polished chrome plate face in tile walls.
B. Ceilings: Provide Acorn #8211-3-AKL or Josam #SLA bonderized prime-coated steel face with Allen lock and key. Finish to match surrounding.

2.5 BUILDING WATER METER

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Hersey, Division of Mueller Company MVR (4”)
2. Badger.
B. Provide magnetic drive vertical turbine meter capable of low flow conditions. Meter shall be able to be installed vertically or horizontally.
C. Meter shall comply with ANSI/AWWA Standard C701 Class 1 and NSF 61 Standard.
D. Construction shall have the following: Maincase, Rotor Assembly and permanently sealed register.
1. Maincase shall be made of bronze.
2. Rotor assemblies shall be made of thermoplastic for dimensionally stability and will not corrode. Unit shall have stainless steel shaft and internal strainer. No external strainer. Design shall extend the life of meter.
3. Permanently sealed register shall have a seal and heat treated glass to eliminate dirt, moisture infiltration and lens fogging. The totalizing register has a straight-reading odometer type display, a 360 degree test circle with center sweep hand and a low flow (leak) detector.
E. Accessories
1. Built in test ports.
2. Translator register shall be pulse output to existing building management system. Confirm with Towson State University regarding requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
B. Install water hammer arresters in water piping according to PDI-WH 201.
C. Install per manufacturer’s requirements.

3.2 LABELING AND IDENTIFYING
A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
   1. Calibrated balancing valves.

3.3 FIELD QUALITY CONTROL
A. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.
B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.
C. Prepare test and inspection reports.

3.4 ADJUSTING
A. Set field-adjustable flow set points of balancing valves.

END OF SECTION 221119
SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division Specification Sections, as applicable, shall apply to this section.

1.2 SUMMARY
   A. This Section includes the following for soil, waste, and vent piping inside the building:
      1. Pipe, tube, and fittings.
   B. The work under this Section of the Specification shall include the furnishing of labor, materials and equipment for the installation of complete sanitary waste and vent piping system to provide continuous and satisfactory service.
   C. Sanitary piping shall be extended from fixtures and appliances requiring connection to an existing sanitary serving the existing building. Verification of existing location, existing pipe size and invert of the existing piping is required. Adjust new pipe slope as required and meets plumbing code.

1.3 PERFORMANCE REQUIREMENTS
   A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:

1.4 INFORMATIONAL SUBMITTALS
   A. Provide informational submittals in Operation and Maintenance Manuals in addition to action submittals and section 017823 “Operation and Maintenance Data”.
   B. Field quality-control inspection and test reports.

1.5 QUALITY ASSURANCE
   A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 PIPING MATERIALS
A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

B. All Cast Iron Pipe must have CISPI trademark seal.

C. No Heat fusion piping allowed.

D. No galvanized or PVC piping allowed.

E. Sanitary and vent piping above grade in the building must be cast iron.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS
A. Pipe and Fittings: ASTM A 74, Service and Extra Heavy classes.

B. Gaskets: ASTM C 564, rubber.

2.4 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS
A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.

   1. Standard, Shielded, Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve. Use 4 band huskies or equal with stainless steel corrugated bands for 3” and larger No-hub sanitary pipes (vertical/horizontal). Sanitary vents shall use standard 2 band except where vents are used as a wet vent where a 4 band huskie or equal is required.

      a. Manufacturers:
         1) Charlotte Pipe and Foundry
         2) Tyler Pipe; Soil Pipe Div.
PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated. Sanitary piping shall have long radius elbows.

B. Aboveground, soil and waste piping NPS 4 and smaller shall be the following:
   1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
   2. Hubless cast-iron soil pipe and fittings, shielded, stainless-steel couplings; and hubless-coupling joints.

C. Aboveground, vent piping NPS 4 and smaller shall be the following:
   1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
   2. Hubless cast-iron soil pipe and fittings, shielded, stainless-steel couplings; and hubless-coupling joints.

3.2 PIPING INSTALLATION

A. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

C. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

D. No double wyes or tees allowed.

E. No offset toilet flanges allowed.

F. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.

G. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."

H. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
   1. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
   2. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

I. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
3.3 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."

3.4 VALVE INSTALLATION

A. Backwater Valves: Install backwater valves in piping subject to sewage backflow.
   1. Horizontal Piping: Horizontal backwater valves.

3.5 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping to the following:
   1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
   2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
   3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
   4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection.

3.6 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
   1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
   2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.

2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.

3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.

4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.

5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.

6. Prepare reports for tests and required corrective action.

7. After pressure tests are complete all sanitary and piping 3” and larger located under slab will need to be videotaped by a third party to the first manhole or clean-out located outside of the building. Towson University will need to notified at least 24 hours prior to the test. A copy of the video is to be delivered to the Towson University.

3.7 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 221316
SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division Specification Sections, as applicable, shall apply to this section.

1.2 SUMMARY
   A. This Section includes the following sanitary drainage piping specialties:
      1. Cleanouts.
      2. Floor drains.
      3. Trap Primer

1.3 ACTION SUBMITTALS
   A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for the following:
      1. Cleanouts
      2. Floor drains
      3. Trap Primer

   B. Field quality-control test reports.

   C. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.4 INFORMATIONAL SUBMITTALS
   A. Operation and Maintenance Data: For cleanouts and floor drains, provide submittals to include in operation and maintenance manuals

1.5 QUALITY ASSURANCE
   A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

   B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
1.6 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Cleanouts shall be provided at ends of runs, at changes of direction and near the base of each vertical soil, waste, or drain pipe. Cleanouts shall be placed on horizontal lines every 50 feet unless the conditions require them at closer intervals. Cleanouts at the base of vertical pipes shall be placed in a fitting just above the floor. Cleanouts to be within 2” of finished surface. Cleanouts shall consist of Y branches or 1/4 bends the full size of the line for piping 4 inches and smaller, and 4 inches for larger pipes. Cleanouts in horizontal lines shall be extended to floor level or grade as necessary. Vandal-proof screws. Cleanouts shall be series as listed below:

B. Below concrete floors with no finish or ceramic tile finish.
   1. Zurn - ZN-1400-3
   2. J. R. Smith - 4041

C. Below carpeted floors (flush with concrete with identification screw through carpet).
   1. Zurn - ZN-1400-15
   2. J. R. Smith - 4020-Y

D. Below resilient tile floors.
   1. Zurn - ZN-1400-7
   2. J. R. Smith - 4160

E. Exposed horizontal piping.
   1. Zurn - Z-1440A
   2. J. R. Smith - 4400

F. Concealed in finished wall-prime coat.
   1. Zurn - Z-1440-1
   2. J. R. Smith - 4402

G. Base of exposed vertical pipes.
   1. Zurn - Z-1445
   2. J. R. Smith - 4510

H. Base of concealed vertical pipes.
   1. Zurn - Z-1445-1
   2. J. R. Smith - 4530

I. Cleanouts shall consist of cast iron ferrules and shall seat against a lead seal. Access covers shall be polished nickel bronze in finished areas, brass below carpeting. Access covers will be secured by non-ferrous tamperproof screws.
2.2 FLOOR DRAINS

A. Floor drains shall be served by trap primers.

B. Floor drains shall be deep seal and the following type:
   1. FD-1 -cast iron adjustable nickel bronze 8 inch round strainer.
      a. Zurn Z415B
      b. J. R. Smith

2.3 TRAP PRIMER

A. Provide trap primer for floor drain. Extend from flushometer valve of water closet to floor drain trap. See specification section 224213.13.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. No double wyes or tees allowed.

C. Install cleanouts in aboveground piping and building drain piping.

D. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

E. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

F. Cleanouts installed in walls must be located within 2” of the finished wall or it must be extended to within 2” of the finished wall.

G. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
   1. Position floor drains for easy access and maintenance.
   2. Set floor drains below elevation of surrounding finished floor to allow floor drainage.
   3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
   4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

H. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
   1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
   2. Size: Same as floor drain inlet.
I. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

J. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.3 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319
SECTION 224000 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division Specification Sections, as applicable, shall apply to this section.

1.2 SUMMARY

A. This Section includes the following conventional plumbing fixtures and related components:
   1. Sinks.
   2. Ice maker box for refrigerator

B. The work under this Section of the Specification shall include the furnishing of labor, materials and equipment for the installation of complete system to provide continuous and satisfactory service.

1.3 DEFINITIONS


B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.

C. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.

D. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.

E. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.

F. FRP: Fiberglass-reinforced plastic.

G. PMMA: Polymethyl methacrylate (acrylic) plastic.

H. PVC: Polyvinyl chloride plastic.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, flow-control rates, diagram power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.

D. Warranty: Special warranty specified in this Section.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.


E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

PART 2 - PRODUCTS

2.1 PLUMBING FIXTURES

A. Mounting Heights of Fixtures
1. To provide for the physically disabled, plumbing fixtures shall be provided for their use at a mounting height suitable for the disabled as set forth by the Federal Government. Fixtures for special uses need not meet this requirement. Fixture mounting heights are generally indicated on the drawings.

2. Hot water and drain piping accessible to a wheelchair patient shall be suitably protected against high temperature by molded vinyl piping covers with access to shut-off valves, trap cleanout, etc. Insulation shall have out of sight fastening system, tie bands are not approved. Covers shall be Truebro 105/102.

B. Hot and cold water connections to fixtures shall be provided with a stop valve. Stop valves, risers, etc. shall be commercial/institutional grade as manufactured by Brass Craft, Chicago, Engineered Systems or McGuire.

C. Provide water temperature limiting device conforming ASSE 1070 as required by code.

D. Provide metal supports necessary to adequately and substantially hang and set fixtures. Supports shall be Zurn, Josam or J. R. Smith and suitable for the wall thickness and piping arrangements shown.

E. For sinks and fixtures specified under other Divisions or other contracts and not provided with faucets, tailpieces, traps, and stop valves; provide necessary fittings and completely connect the sinks and fixtures.

F. Plumbing fixtures shall be caulked at wall and floor with silicone caulking material of same color as the fixture.

G. All plumbing fixture trim is to have vandal resistant fittings and fasteners.

H. Maximum length of domestic water risers for lavatories and sinks is 8 inches.

I. Connect domestic water recirculation line no more than 2 feet from fixture.

J. No motion sensor flushometers or faucets allowed.

K. Fixtures shall be as follows:
   1. P-1 WATER CLOSET
      a. See specification section 224213.13 Water Closet
   2. P-2 LAVATORY
      a. See specification section 224216.13 Lavatory
   3. P-3 SINK
      a. Single compartment 18 gauge, type 304 stainless steel, drop in sink. Sink bowl shall be 24 x 16 x 8 deep. Provide chrome plated cast brass P trap and stop valves in the supply pipes. Underside and sides shall be coated with sound deadening material. Mount sink in counter furnished under another division.
      b. Model
         1) Elkay LSR2722
         2) Just
         3) Approved equal
      c. Faucet – Vandal resistant widespread faucet dual wristblade handles, 8” rigid gooseneck spout and chrome finish. .5 gpm aerator.
1) American Standard Monterrey 6409.170
2) Just
3) Elkay
d. Drain - stainless steel drain with removable grid strainer and tailpiece.
   1) Elkay LK99
   2) Just

4. P-4 ICE MAKER BOX FOR REFRIGERATOR
   a. Refrigerator provided by owner or under another division of the specification. Provide connections only and make connection under division 22.
   b. Ice maker box.
      1) Provide an ice maker box suitable for flush mounting. Box shall be constructed of stainless steel with lead free domestic valve. Valves shall comply with ASME A112.18.1.
      2) Box shall be Guy Gray model SSIB2AB

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.
   B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.
   C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION
   A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.
   B. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
   C. Install wall-mounting fixtures with tubular waste piping attached to supports.
   D. Install floor-mounting, back-outlet water closets attached to building floor substrate and wall bracket and onto waste fitting seals.
   E. Install counter-mounting fixtures in and attached to casework.
   F. Install fixtures level and plumb according to roughing-in drawings.
   G. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
1. Exception: Use ball, gate, or globe valves if supply stops are not specified with fixture. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

H. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.

I. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.

J. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

K. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.

L. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

M. Provide and install water temperature limiting devices as required by code.

N. Install per manufacturer’s requirements.

O. Install traps on fixture outlets.

P. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."

Q. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

3.4 FIELD QUALITY CONTROL

A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.

B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.

C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

3.5 ADJUSTING

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow and stream.

C. Replace washers and seals of leaking and dripping faucets and stops.

3.6 CLEANING

A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
   
   1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
   2. Remove sediment and debris from drains.

B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.7 PROTECTION

A. Provide protective covering for installed fixtures and fittings.

B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224000
SECTION 224213.13 - COMMERCIAL WATER CLOSETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division Specification Sections, as applicable, shall apply to this section.

1.2 SUMMARY

A. Section includes:
   1. Water closets.
   2. Flush valves.
   3. Toilet seats.
   4. Fixture supports.

B. The work under this Section of the Specification shall include the furnishing of labor, materials and equipment for the installation of complete system to provide continuous and satisfactory service.

C. Related Sections
   1. Division 10 Section “Toilet and Bath Accessories”
   2. Division 22 Section “Domestic Water Piping Specialties”.
   3. Section 224216.13 “Commercial Lavatories.”

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for water closets.
   2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.4 INFORMATIONAL SUBMITTALS

A. Provide informational submittals in Operation and Maintenance Manuals in addition to action submittals and section 017823 “Operation and Maintenance Data”.

B. Operation and Maintenance Data: For flushometer valves to include in operation and maintenance manuals.
PART 2 - PRODUCTS

2.1 WATER CLOSETS

A. **P-1A Water Closet**: Floor mounted, top spud. ADA Compliant.
   1. Manufacturers: Subject to compliance with requirements, provide products by American Standard:
      a. Model
         1) American Standard - Madera - 3043.001
   2. Bowl:
      b. Material: Vitreous china.
      c. Type: Siphon jet.
      d. Style: Flushometer valve.
      e. Height: ADA Compliant.
      g. Water Consumption: 1.28 gal. per flush.
      h. Spud Size and Location: NPS 1-1/2; top.
      i. Color: White
   3. Flushometer Valve:
      a. Manufacturer:
         1) Sloan Royal 111 Optima Smooth, Battery Powered Infrared Sensor
      b. ADA Compliant
      c. Standard: ASSE 1037.
      d. Features: Include integral check stop, vacuum breaker, trap primer, vandal resistant controls top cap and backflow-prevention device.
      e. Exposed Flushometer-Valve Finish: Chrome plated.
      f. Style: Exposed.
      g. Consumption: 1.28 gal. per flush.
   4. Toilet Seat:
      a. Manufacturer: Olsonite #95
      d. Type: Commercial (Heavy Duty).
      e. Shape: Elongated rim, open front without cover.
      f. Hinge: Self Sustaining Concealed check.
      g. Hinge Material: Stainless steel posts and Pintles.
      h. Color: White.
   5. Support:
      a. Standard: ASME A112.6.1M.
      b. Description: Waste-fitting assembly as required to match drainage piping material and arrangement with faceplates, couplings gaskets, and feet; bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.
2.2 EXAMINATION
   A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before water-closet installation.
   B. Examine walls and floors for suitable conditions where water closets will be installed.
   C. Proceed with installation only after unsatisfactory conditions have been corrected.

2.3 INSTALLATION
   A. Water-Closet Installation:
      1. Install level and plumb according to roughing-in drawings.
   B. Flush-Valve Installation:
      1. Install flush-valve, water-supply fitting on each supply to each water closet.
      2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
   C. Install toilet seats on water closets.
   D. No offset toilet flanges allowed.
   E. Wall Flange and Escutcheon Installation:
      1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
      2. Install deep-pattern escutcheons if required to conceal protruding fittings.
   F. Joint sealing:
      1. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
      2. Match sealant color to water-closet color.
      3. Comply with sealant requirements specified in Section 079200 “Joint Sealants.”

2.4 CONNECTIONS
   A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.
   B. Comply with water piping requirements specified in Section 221116 “Domestic Water Piping.”
   C. Comply with soil and waste piping requirements specified in Section 221316 “Sanitary Waste and Vent Piping.”
   D. Compression valves are not permitted on domestic water.
   E. Where installing piping adjacent to water closets, allow space for service and maintenance.
2.5 ADJUSTING
   A. Operate and adjust water closets and controls. Replace damaged and malfunctioning water closets, fittings, and controls.
   B. Adjust water pressure at flush valves to produce proper flow.

2.6 CLEANING AND PROTECTION
   A. Clean water closets and fittings with manufacturers’ recommended cleaning methods and materials.
   B. Install protective covering for installed water closets and fittings.
   C. Do not allow use of water closets for temporary facilities unless approved in writing by Owner.

END OF SECTION 224213.13
SECTION 224216.13 - COMMERCIAL LAVATORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division Specification Sections, as applicable, shall apply to this section.

1.2 SUMMARY

A. Section includes:
   1. Lavatories.
   2. Faucets.

B. The work under this Section of the Specification shall include the furnishing of labor, materials and equipment for the installation of complete system to provide continuous and satisfactory service.

C. Related Sections
   1. Division 10 Section “Toilet and Bath Accessories”
   2. Division 22 Section “Domestic Water Piping Specialties”
   3. Section 224213.13 “Commercial Water Closets.”

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for lavatories.
   2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.4 INFORMATIONAL SUBMITTALS

A. Provide informational submittals in Operation and Maintenance Manuals in addition to action submittals and section 017823 “Operation and Maintenance Data”.

B. Operation and Maintenance Data: For lavatories and faucets to include in operation and maintenance manuals.
   1. In addition to items specified in Section 017823 “Operation and Maintenance Data,” include the following:
      a. Servicing and adjustments of automatic faucets.
PART 2 - PRODUCTS

2.1 LAVATORIES

A. **P-2 Lavatory:** Rectangular, wall-mounted. 20" x 18" white vitreous china, coordinate faucet spacing, splash back lavatory with clearance below waste outlet and to accommodate concealed arm supports. Fixture shall comply with ADA requirements. Provide with commercial weight loose key stop valves, flexible risers, and adjustable 1-1/4" x 1-1/2" cast brass P trap with cleanout, trap nipple, and escutcheon. Provide with concealed arm wall hanger system with legs anchored to floor.
   1. Model
      b. Kohler
   2. Faucet – WaterSense vandal resistance deck mounted infrared proximity sensor faucet with 10 second time out feature. Chrome plated cast brass spout, battery powered, in line filter, water conserving .5 gpm vandal-resistant non aerating, ADA compliant, temperature mixing valve and offset tailpiece.
      a. Model
         1) Zurn Z6913-XL
         2) American Standard
         3) Kohler
   3. Supply pipes and drain shall be protected by 3/16" thick white molded all vinyl internally ribbed insulation with access for stop valves, trap, etc.
      a) Model
         1) Truebro105/102

2.2 SUPPLY FITTINGS


B. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless-steel wall flange.

C. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or FIP (Female Iron pipe) valve with inlet connection matching supply piping.

D. Compression valves are not permitted on domestic water.

E. Operation: Loose key.

F. Risers:
   1. ASME A112.18.6, braided-or corrugated-stainless-steel, flexible hose riser.

2.3 WASTE FITTINGS

A. Standard: ASME A112.18.1/CSA B125.2.
B. Drain: Grid type with NPS 1-1/4 offset and straight tailpiece.

C. Trap:
   2. Material: Chrome-plated, two-piece, cast-brass trap and ground-joint swivel elbow with 0.032-inch-thick brass tube to wall; and chrome-plated, brass or steel wall flange.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before lavatory installation.

B. Examine walls for suitable conditions where lavatories will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install lavatories level and plumb.

B. Provide and install water temperature limiting device conforming ASSE 1070 as required by code.

C. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings.

D. Seal joints between lavatories, counters, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 “Joint Sealants.”

E. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Truebro105/102

3.3 CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 22116 “Domestic Water Piping.”

C. Comply with soil and waste piping requirements specified in Section 221316 “Sanitary Waste and Vent Piping.”
3.4 ADJUSTING

A. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

3.5 CLEANING AND PROTECTION

A. After completing installation of lavatories, inspect and repair damaged finishes.

B. Clean lavatories, faucet and other fittings with manufacturers’ recommended cleaning methods and materials.

C. Provide protective covering for installed lavatories and fittings.

D. Do not allow use of lavatories for temporary facilities unless approved in writing by Owner.

END OF SECTION 224216.13
SECTION 230500 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division Specification Sections, as applicable, shall apply to this section.

B. References

1. 2015 International Existing Building Code
2. 2015 International Building Code
3. 2015 International Mechanical Code
4. 2015 International Plumbing Code
5. 2015 International Energy Conservation Code
6. NFPA Standards
7. ASHRAE Handbooks and Manuals
8. SMACNA Manuals

1.2 DEFINITIONS

A. Piping" includes pipe, fittings, valves, hangers, and other accessories that comprise a system.

B. "Ductwork" includes ducts, fittings, housings, dampers, hangers, and other accessories, which comprise a system.

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

D. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces, mechanical and electrical equipment rooms, air handling unit service corridors, and accessible shafts.

E. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations and at grade locations.

F. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings, chases, and duct shafts.

G. 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.
H. Conditioned Space: Finished spaces and exposed interior spaces that are air conditioned. Examples include offices, corridors, etc., that are served by air conditioning equipment. Return-air plenums are not conditioned space.

I. Return-air Plenums: Space between ceiling and structure above when return air is transferred from space to ceiling plenum in lieu of directly ducting return air from the space.

J. K-Factor: Number of British thermal units of heat transmitted per square foot per degree Fahrenheit temperature difference through a material with flat, parallel sides one inch apart.

1.3 SUBMITTALS

A. Welding certificates.

B. Certificates of Compliance for pressure vessels.

C. Submit shop drawings or product cut sheet showing construction size, arrangement, operating clearances, performance characteristics and capacity of materials and equipment. Each item of equipment proposed shall be a standard catalog product of the approved manufacturer.

D. Samples, drawings, specifications, catalogs, etc., submitted for approval shall be properly labeled indicating specific service for which material or equipment is to be used.

E. Submit access door locations to the Architect for approval. Equipment requiring access doors shall not be installed prior to approval of access door locations.

F. Coordination Drawings:

1. Provide coordination drawings in accordance with Division 1 Section “Project Management and Coordination”. Detail major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components (i.e. electrical, plumbing, sprinkler, structural and architectural work). Show space requirements for installation and access. Indicate if sequence and coordination of installations are important to efficient flow of the Work. Include the following:

   a. Planned piping layout, including valve and specialty locations and valve-stem movement.
   b. Clearances for installation and maintaining insulation.
   c. Clearances for servicing and maintaining equipment, accessories, and specialties, including space for disassembly required for periodic maintenance.
   d. Equipment and accessory service connections and support details.
   e. Fire-rated wall and floor penetrations.
   f. Sizes and location of required concrete pads and bases.
   g. Scheduling, sequencing, movement, and positioning of large equipment into building during construction.
   h. Floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
   i. See Division 23, Section “Metal Ducts” for ductwork installation drawing requirements.
j. Reflected Ceiling Plans:

1) Ceiling suspension assembly members.
2) Other systems installed in same space as ducts.
3) Ceiling- and wall-mounting access doors and panels required to provide access to dampers and other operating devices.
4) Ceiling-mounting items, including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special molding.
5) Refer to architectural ceiling plans for additional requirements.

1.4 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. Materials furnished and work installed shall comply with the latest issue of the codes, rules, regulations, and recommendations.

1.5 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. Proper and suitable tools, equipment and appliances for the safe and convenient handling and placing of materials and equipment shall be used. During loading, unloading, and placing, care shall be taken in handling the equipment and materials so that no equipment or materials, including Owner furnished, are damaged.

C. Mechanical equipment delivered to the job site shall be stored under roof or other approved covering, on pedestals above the ground. Enclosures for equipment shall be weatherproof. Any motors involved in the work that are not totally enclosed and electrical/electronic components shall be stored in a heated area with a minimum temperature of 50 deg. F. Valves shall be stored under roof on wood pedestals above ground. Pipe for project use shall be stored above grade in such a manner to prevent entrance of foreign materials. Pipe shall be fitted with end caps or seals to prevent moisture and debris from entering pipe. Insulation shall be store under roof or in trailers, adequately protected from the weather. Follow written instructions and recommendations of the manufacturer and requirements of the Architect in lubrication, protection, and maintenance of equipment during storage.
D. If materials or equipment are found to be in poor condition at the time of being installed, the Architect may, at his discretion, order the Contractor to furnish and install new equipment or materials at no cost to the Owner.

1.6 GENERAL

A. Regulatory Requirements

1. Work shall conform to the requirements of the codes, laws and ordinances of Baltimore County, Maryland; National Fire Protection Association, American Society of Mechanical Engineers; and other authorities having jurisdiction.

2. Comply with applicable codes, laws, standard practices.

3. Comply with the standards of good practice as outlined in ASHRAE handbook and manuals, the Sheet Metal and Air Conditioning Contractor's Association's "Duct Manual", and the Apprentice Training Manual of the Steam Fitters Union.

B. Electrical Characteristics for Mechanical Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

C. Control wiring:

1. Class 1 Control Circuits: Type THHN-THWN, in raceway (3/4” conduit minimum), unless otherwise noted.

2. Class 2 Control Circuits: Type THHN-THWN, in raceway (3/4” conduit minimum), unless otherwise noted.

D. Give necessary notices and obtain required permits. Pay fees and other costs, including utility connections or extensions in connection with the work. File necessary plans, prepare documents and obtain necessary approvals of governmental agencies having jurisdiction. Obtain required certificates of inspection and deliver same to the Architect before request for acceptance and final payment for the work.

1.7 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 other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors."

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1.8 VARIANCES

A. Where conflicts exist within the contract documents, request clarification prior to the submission of a bid. If clarification is not requested, provide the work representing the higher cost and quality.

1.9 WARRANTY

A. Certain items of equipment shall be warranted for a longer time than the general warranty period. Provide for service or replacement required in connection with the warranty of these items

B. See Division 1 and General Conditions for general requirements.

C. Provide service of the equipment manufacturer or his authorized representative, if required to achieve specified performance of equipment provided.

D. During the warranty period, service equipment provided except filter replacement and belt replacement. Provide labor and materials in accordance with manufacturer’s written instructions for service and maintenance. Prior to the start of warranty period, provide to the Architect for approval, a schedule of required maintenance operations to be performed during the warranty period and required periodically thereafter for each system and item of equipment. Thereafter, monthly reports shall be submitted to the Owner for describing actual service performed. Forty-eight (48) hours advance notice shall be given to Owner prior to work required.

E. All equipment, labor and systems shall be guaranteed by the Contractor for period of two years minimum unless otherwise noted after the date of substantial completion. Contractor shall be fully responsible for all repairs and adjustments to equipment and systems during this guaranty period.

F. Repairs and replacements: If the Owner finds work that is defective, inferior or not in compliance with the Contract during the guarantee period the Owner will inform the Contractor in writing. The Contractor shall promptly perform the following at no additional cost to the owner:

1. Replace all defective work in a satisfactory manner.
2. Correct all damage to the building or contents which occurred due to the defective work.

G. The Owner may choose to have defective work corrected at the expense of the Contractor if the Contractor fails to proceed promptly to repair defective work in an accordance with this guarantee.

1.10 MATERIALS AND WORKMANSHIP

A. Items shown and not specifically called for, or items specified and not specifically indicated or detailed on the Drawings, or items neither specified nor shown, but which are reasonably incidental to and commonly required. Shall be provided.
B. Furnish the services of an experienced full time field superintendent who shall be constantly in charge of the installation of work provided under this Division. Superintendent shall have demonstrated experience with projects of comparable size and complexity.

C. The quality of workmanship required in the execution of the work shall be the finest and highest obtainable, working with the materials specified. Workmanship shall be satisfactory to the Architect and his decision as to acceptable quality is final.

1.11 EQUIPMENT START-UP AND INITIAL OPERATION

A. No equipment shall be operated for testing or trial use until there has been full compliance with the equipment manufacturers’ specifications and instructions for lubrication, alignment, direction of rotation, balance, and other applicable considerations.

B. Particular care shall be taken to verify that equipment is completely assembled and properly lubricated, and grease and oil cases and reservoirs have been filled to the correct level with the recommended lubricant.

C. Where specified, provide services of the manufacturer or his authorized representative to witness, supervise, or assist in the installation and start-up equipment provided under this Division.

1.12 DRAWINGS

A. The contract drawings are generally indicative of the work to be installed, are diagrammatic and indicate the general arrangements of systems, but they do not show all offsets, fittings and similar details required, which shall be provided to meet the job conditions. In areas where work is installed in close proximity to work of other trades or within trades covered by this Division of the Specifications, prepare larger scale drawings consisting of plans and sections to show how work is to be installed in relation to work of other trades.

B. Do not scale the drawings. Consult the other disciplines drawings for locations (such as structure and equipment); where same are not precisely located, obtain this information prior to start of work.

C. Although the location of materials and equipment may be shown on the drawings in a certain place, the construction may develop conditions that render this location inaccessible or impractical. Before fabricating and installing the work, the Contractor shall call the condition to the attention of the Architect for direction of any materials and/or equipment inaccessible or impractical. When requested by the Architect a detailed drawing of the proposed departure due to field conditions, or their causes, shall be submitted by the Contractor for approval. The Architect shall make final written decisions as to the conditions, which require the changing of work.

1.13 RECORD DRAWING

A. See Division 1, for general requirements.
B. Carefully record the actual locations of each piece of concealed equipment, control devices, pipe, valves, ducts, terminal units, etc., and work when different from the contact drawings.

1.14 OPERATING AND MAINTENANCE INSTRUCTIONS

A. See Division 1 for general requirements of demonstration and training.

B. Upon completion of work and of tests, furnish the necessary skilled labor and helpers for operating and demonstrating the systems and equipment.

C. The instructor shall be thoroughly familiar with parts of the installation on which he is to give instruction and shall be trained in operating theory as well as practical operation and maintenance work. Employ factory trained instructors wherever necessary and as specified.

D. Instructions shall include a general description of each system together with specific instructions describing routine and emergency procedures required of the building personnel for operating and maintaining each system. The instructions shall include the name or label, location, and function of operating equipment and controls. Operating modes and the procedures for indexing each mode shall be clearly described. Include lubrication charts and schedules of frequency of lubrication for equipment, designating each point of lubrication and type of lubrication to be used. Listings of names, addresses, and phone numbers of the service organizations for each items of equipment and a typewritten maintenance schedule for same shall be included.

E. Provide operation and maintenance manuals and record product data as specified in Division 1.

1.15 FIRE PREVENTION

A. As minimum, one five-pound CO₂ extinguisher shall be provided with each work crew.

1.16 SINGULAR NUMBER

A. See Division 1 for general requirements.

B. Where any device or part of equipment is herein referred to in the singular number, such as “value”, such reference applies to as many such devices as are required to complete the installation, shown or implied.

1.17 SUBMITTALS

A. Submittal review by the Engineer is intended to assist Contractor in his ability to comply with the Contract Documents. Review of submittal is only for general conformance with the design concept as given in Contract Documents. Where Contractor Submittals do not clearly indicate the intended materials for use, they may be returned without review or be rejected. Where differences between Contract Documents and Submittals are not noted, Contractor shall comply with requirements of Contract Documents. Contractor accepts all responsibility for quantities, dimensions, details, coordination of trades and job safety.
B. Definition:

1. Action Submittals: Submit to Engineer for review.
2. Informational Submittals: Provide submittals in Operational and Maintenance Manuals.

C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Engineer’s receipt of submittal.

1. Initial Review: Allow 10 working (business) days for initial review of each submittal. Allow Additional time if coordination with subsequent submittals is required. Engineer will advise Architect when a submittal being processed must be delayed for coordination.
2. Resubmittal review: Allow 10 working (business) days for each resubmittal.
3. Engineer will review an initial submittal and one (1) resubmittal. Any additional reviews shall be billed to the General Contractor on an hourly basis at the Engineer’s current billing rates and will not be returned to the General Contractor until payment has been received. This shall not be cause for any delay claims or additional compensation claims by the General Contractor to the Owner.

PART 2 - PRODUCTS

2.1 PRODUCTS TO BE USED

A. Items are specified by designations such as trade name, manufacturer's name, catalog number and indicate the capacity and quality of the products or materials to be used on this project.

B. Only products indicated on Contract Documents by name and model number have been coordinated with other trades. Coordinate items of other manufacturer with other trades.

C. The work under this Section of the Specification shall include the furnishing of labor, materials and equipment for the installation of complete plumbing system to provide continuous and satisfactory service.

2.2 EQUIPMENT SUPPORTS

A. Provide supports, curbs and bases for equipment, as necessary for satisfactory installation and operation of equipment. Furnish and set anchor bolts. Provide vibration isolation.

2.3 MOTOR STARTING EQUIPMENT

A. Unless otherwise specified, motor control centers, starters, disconnect switches and variable frequency controllers shall be provided by the Division 26 Contractor. Refer to Division 26 Sections for requirements.

2.4 DRIP PANS ABOVE ELECTRICAL OR ELECTRONIC EQUIPMENT

A. Do not route mechanical piping directly above electrical (or electronic) equipment; if not possible to avoid provide drip pans under mechanical piping, sufficient to protect electrical
work from drips. Locate pan immediately below piping, and extend a minimum of 6” on each side of piping and lengthwise 18” beyond the protected equipment. Fabricated pans of reinforced metal 2” deep, with rolled edges and soldered or welded seams; metal shall be 20 gage copper or 18 gage steel with 2 oz. zinc finish hot dipped after fabrication. Provide a minimum of 3/4” copper drainage piping, discharging to nearest floor drain, service sink, or as directed via air gap and per code.

2.5 PACKING MATERIAL FOR PENETRATIONS

A. Mineral fiber; non-combustible; resistant to water, mildew, and vermin. Expanding resilient foams manufactured for this purpose are an acceptable alternative only if the material density is at least 3.0 pounds per cubic foot.

2.6 FIRESTOPPING

A. See additional information in Division 7.

B. System description

1. Firestopping shall consist of furnishing and installing a material or combination of materials to form an effective barrier against the spread of flame, smoke, and gases, and maintain the integrity of fire resistance rate walls, barriers, partitions, floors, floor/ceiling/roof assemblies, including through penetrations and construction joints. Through-penetrations include the annular spaces around pipes, tubes, conduits, wires, cables, and vents. Construction joints include those used to accommodate expansion, contraction, wind, or seismic movement; firestopping materials shall not interfere with required movement of joints.

C. Storage and delivery

1. Materials shall be delivered in the original un-opened packages or containers showing names of the manufacturer and the brand name of the product. Materials shall be stored off the ground and shall be protected from damage and exposure to elements. Damaged or deteriorated materials shall be removed from the site.

D. Firestopping materials

1. Firestopping materials shall consist of commercially manufactured products complying with the following minimum requirements:

2. Fire hazard classification: material shall have a flame spread of 25 or less, and a smoke developed rating of 50 or less, when tested in accordance with ASTM E 84 or UL 723. Materials shall be non-toxic to humans at all stages of the application and performance of the materials.

3. Fire resistance rating: firestopping will not be required to have a greater fire resistance rating than that of the assembly in which it is being installed within. Fire resistance ratings of construction joints and gaps such as the construction in which they occur.
PART 3 - EXECUTION

3.1 MANNER OF INSTALLATION

A. Piping and ductwork shall be installed to preserve access to valves, dampers and equipment. Valves, dampers and equipment which require frequent service, adjustment or control and which cannot be located in a readily accessible and safe place, shall be provided with extension devices and remote operators, as necessary and as accepted for use by the Architect.

B. Piping and ductwork shall be run to follow the lines of the building and to allow the maximum headroom consistent with proper pitch. Piping subject to thermal expansion shall be arranged to permit movement without damage to the piping, ductwork and equipment.

3.2 EQUIPMENT CONNECTIONS

A. Equipment shall be installed and connected in accordance with the best engineering practice and in accordance with manufacturer’s instructions and recommendations. Auxiliary piping, valves, and electric connections recommended by the manufacturer or required for proper operation shall be provided.

3.3 PIPING SYSTEMS - COMMON REQUIREMENTS

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

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

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

D. Install piping at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling 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 low point drains and airvents.

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

K. Install piping to allow application of insulation.
L. Select system components with pressure rating equal to or greater than system operating pressure.

M. Install escutcheons for penetrations of walls, ceilings, and floors.

N. Permanent sleeves are not required for holes formed by removable PE sleeves.

O. Unless indicated otherwise, sleeves are not required for core-drilled penetrations in solid concrete construction, except when located in floors of mechanical equipment areas or other potential wet areas. Seal annular space between pipe or pipe insulation and concrete as specified for sleeves.

P. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

Q. 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.
   a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches 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 annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
   a. PVC or Steel Pipe Sleeves: For pipes smaller than NPS 6.
   b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
   c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.

   1) Seal space outside of sleeve fittings with grout.

R. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

S. Verify final equipment locations for roughing-in.

3.4 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.

2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations. In no case shall equipment be installed with service clearance less than manufacturer’s recommendations.

D. Install equipment to allow right of way for piping installed at required slope.

3.6 PAINTING

A. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish. Provide complete new finish if, in the opinion of the Architect or Owner, the factory finishes are severely damaged.

1. Touch up threads of zinc coated screwed pipe with Rustoleum primer and one coat of enamel conforming to painting specification.

3.7 CUTTING AND PATCHING

A. See Division 1 for general requirements.

B. Cutting and patching of building materials shall be performed in a neat and workmanlike manner. Surfaces, which are damaged by the Contractor, shall be repaired or provided with new materials. Patching and materials shall be done with materials and methods similar to adjacent work, subject to approval of the Architect. Structural members shall not be cut or penetrated unless indicated on the drawings.

3.8 SURVEYS AND MEASUREMENTS

A. Base measurements, both horizontal and vertical, from established benchmarks. Work shall agree with these established lines and levels. Verify measurements at site and check correctness of same as related to the work.

B. Should the Contractor discover any discrepancy between actual measurements or conditions, and those indicated which prevent following good practice or the intent of the drawings and specifications, he shall notify the Construction Manager and shall not proceed with his work until he has received instruction from the Construction Manager.
3.9 RIGGING OF EQUIPMENT

A. Verify that rigging path for equipment prior to start of work or ordering of materials. Verify accessways and weight carrying capacity of building features, including elevators, floors, walls, ceilings, roofs, and related features. When equipment or sections of equipment are larger than available accessways, equipment shall be ordered in a knocked-down configuration for re-assembly at the site. Submit in writing to Architect where problems are encountered that may prohibit rigging of equipment into space with the proposed solutions.

B. Use planking or cribbing as required to protect adjoining construction from damage. Protect equipment from damage until construction is completed.

3.10 WELDING

A. Welding piping shall comply with the provisions of the latest revision of the ASME Code for Pressure Piping, ANSI/ASME B31.1 - Power Piping, and ANSI/ASME B31.9 – Building Services Piping, Contractor shall comply with requirements of federal, state or local agencies having legal jurisdiction that are more stringent than the above ANSI/ASME Codes.

B. State, country, and city fire prevention code requirements, fire and safety regulations, and NFPA 241 shall be complied with, including the provision of appropriate portable fire extinguishers. Prior to performing welding within the building, notify the Construction Manager in advance of areas where welding will occur, and submit for approval a plan for protection of the building and occupants. Proceed only upon receipt of Construction Manager’s approval and provide reasonable barriers, coverings, etc., as required or requested by the Construction Manager for protection of the installed work and building occupants. In regards to welding operations within the building, maintain a negative pressure within the work area to prevent the migration of smoke and fumes to occupied areas of the building. Provide temporary exhaust fans and smoke removal systems as required – discharge of smoke and fumes shall be to the building exterior in a manner to not be recirculated back into building through areaways, windows, etc. and away from public accessway.

C. Provide single-vee type butt welds, unless specified otherwise. Joint configuration shall conform to ANSI B16.25.

D. Before welding is performed, submit a copy of the Contractor’s Standard Welding Procedure Specification together with the Procedure Qualification Record as required by Section IX of the ASME Boiler and Pressure Vessel Code.

E. Before a welder shall perform welding, submit a copy of the Manufacturer’s Record of Welder or Welding Operator Qualification Tests as required by Section IX of the ASME Boiler and Pressure Vessel Code.

F. Welds shall have penetration complete to the inside diameter of the pipe and the recommended spacing and bevels between ends of pipe prior to welding shall be used to assure full penetration for pipe service conditions of 350°F and above (e.g. all medium pressure steam piping). Weld penetrations for pipe service conditions less than 350°F shall be in accordance with the applicable ANSI/ASME Code.
G. Welding at hangers, supports and plates to structural members shall conform to American Welding Society, Inc. AWS D1.1 Structural Welding Code Steel.

H. The use of backing rings shall be at the discretion of the installing Contractor provided that the Contractor prepares and aligns pipes precisely to melt though to the inside surface – making a full penetration weld.

3.11 CLEANING

A. See Division 1, thoroughly clean exposed surfaces of equipment and material and leave in a neat, clean condition ready for painting.

3.12 ACCESSIBILITY

A. Locate equipment that must be serviced, operated or maintained, in fully accessible positions. Equipment shall include, but not be limited to, terminal units, coils, valves, motors, controllers, dampers, drain points, cleanouts, etc. Provide adequate means to access equipment for repair and maintenance including capabilities for platforms, fall protection systems, and anchorage points.

B. Where required or where directed, provide access doors. Doors installed in fire-rated walls or shafts shall be labeled and shall match rating of the construction. Doors shall be sufficient size to allow access to components, except minimum size shall be 16” x 16”. Access panels in ceilings for all plumbing and heating valves to be 24”x 24” minimum. Where equipment requires access to various parts, such as air terminal units require access to the controller and valve and piping appurtenances for the reheat coil, locate appurtenances requiring access such that all devices can be maintained from single door. For items that require access greater than 3 feet above the ceiling, provide minimum 4 feet x 4 feet removable ceiling panel to facilitate top of a folding ladder placed above the ceiling plane. Access doors are specified in Division 8.

C. The Contractor at no expense to the Owner shall rework equipment deemed inaccessible by the Architect.

END OF SECTION 230500
SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on alternating-current power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.2 COORDINATION
A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
   1. Motor controllers.
   2. Torque, speed, and horsepower requirements of the load.
   3. Ratings and characteristics of supply circuit and required control sequence.
   4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS
A. Comply with NEMA MG 1 unless otherwise indicated.

2.2 MOTOR CHARACTERISTICS
A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS
A. Description: NEMA MG 1, Design B, medium induction motor.
B. Efficiency: Premium efficient, as defined in NEMA MG 1.
C. Service Factor: 1.15.
D. Rotor: Random-wound, squirrel cage.

E. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

F. Temperature Rise: One class below insulation rating.

G. Insulation: Class F.

H. Code Letter Designation:
   1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
   2. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristic.

2.4 ADDITIONAL REQUIREMENTS FOR POLYPHASE MOTORS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable-Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
   1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width-modulated inverters.
   2. Premium-Efficient Motors: Class B temperature rise; Class F insulation.
   3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
   4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
   1. Permanent-split capacitor.
   2. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.
PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230513
SECTION 230517 - SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Sleeves.
   2. Grout.

B. Related Requirements:
   1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop collar.

B. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends and integral welded waterstop collar.

C. Galvanized-Steel Sheet Pipe Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.


2.2 GROUT

A. Description: Nonshrink, recommended for interior and exterior sealing openings in nonfire-rated walls or floors.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
   1. Cut sleeves to length for mounting flush with both surfaces.
   2. Using grout, seal space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.
   1. Cut sleeves to length for mounting flush with both surfaces.
   2. Install sleeves that are large enough to provide 1⁄4-inch annular clear space between sleeve and pipe or pipe insulation.
   3. Seal annular space between sleeve and piping or piping insulation; use sealants appropriate for size, depth, and location of joint.

E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke-Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.

B. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.
3.3 SLEEVE AND SLEEVE-SEAL SCHEDULE

1. Concrete Slabs Above Grade:
   a. Piping Smaller Than NPS 6: Steel-pipe sleeves.

2. Interior Partitions:
   a. Piping Smaller Than NPS 6: Steel pipe sleeves.

END OF SECTION 230517
SECTION 230518 - ESCUTCHEONS FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Escutcheons.
2. Floor plates.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

A. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.

B. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed and exposed-rivet hinge; and spring-clip fasteners.

2.2 FLOOR PLATES

A. Split Floor Plates: Steel with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. Escutcheons for New Piping:

   a. Piping with Fitting or Sleeve Protruding from Wall: One-piece deep pattern.
   b. Chrome-Plated Piping: One-piece steel or split-plate steel with polished, chrome-plated finish.
c. Insulated Piping: One-piece stamped steel or split-plate, stamped steel with concealed hinge or split-plate, stamped steel with exposed-rivet hinge with polished, chrome-plated finish.
d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece stamped steel or split-plate, stamped steel with concealed hinge or split-plate, stamped steel with exposed-rivet hinge with polished, chrome-plated finish.
e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece stamped steel or split-plate, stamped steel with concealed hinge or split-plate, stamped steel with exposed-rivet hinge with polished, chrome-plated finish.

C. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
   1. New Piping: Split floor plate.

3.2 FIELD QUALITY CONTROL

A. Using new materials, replace broken and damaged escutcheons and floor plates.

END OF SECTION 230518
SECTION 230519 - METERS AND GAGES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY
   A. Section Includes:
      1. Light-activated thermometers.
      2. Thermowells.
      3. Dial-type pressure gages.
      4. Gage attachments.
      5. Flowmeters.
      6. Thermal-energy meters.

1.2 ACTION SUBMITTALS
   A. Product Data: For each type of product.

1.3 CLOSEOUT SUBMITTALS
   A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 LIGHT-ACTIVATED THERMOMETERS
   A. Direct-Mounted, Light-Activated Thermometers:
      1. Case: Metal; 7-inch nominal size unless otherwise indicated.
      2. Scale(s): Deg F.
      3. Case Form: Adjustable angle.
      5. Stem: Aluminum and of length to suit installation.
         b. Design for Thermowell Installation: Bare stem.
      7. Accuracy: Plus or minus 2 deg F.

2.2 THERMOWELLS
   A. Thermowells:
2. Description: Pressure-tight, socket-type fitting made for insertion in piping tee fitting.
3. Material for Use with Copper Tubing: CNR or CUNI.
4. Material for Use with Steel Piping: CRES CSA.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.3 DIAL-TYPE PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

2. Case: Liquid-filled type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
3. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
4. Pressure Connection: Brass, with NPS 1/4, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
5. Movement: Mechanical, with link to pressure element and connection to pointer.
8. Window: Glass.
10. Accuracy: Grade B, plus or minus 2 percent of middle half of scale range.

2.4 GAGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4, ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.

B. Valves: Brass ball, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

2.5 FLOWMETERS

A. Turbine Flowmeters:

1. Description: Flowmeter with sensor and indicator.
2. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.
3. Sensor: Impeller turbine; for inserting in pipe fitting or for installing in piping and measuring flow directly in gallons per minute.
a. Design: Device or pipe fitting with inline turbine and integral direct-reading scale for water.
b. Construction: Bronze or stainless-steel body, with plastic turbine or impeller.
d. Minimum Temperature Rating: 180 deg F.

4. Indicator: Hand-held meter; either an integral part of sensor or a separate meter.
5. Accuracy: Plus or minus 1-1/2 percent.
7. Operating Instructions: Include complete instructions with each flowmeter.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install thermowells with socket extending to center of pipe and in vertical position in piping tees.
B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
C. Install thermowells with extension on insulated piping.
D. Fill thermowells with heat-transfer medium.
E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.
G. Install duct-thermometer mounting brackets in walls of ducts. Attach to duct with screws.
H. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
I. Install remote-mounted pressure gages on panel.
J. Install valve and snubber in piping for each pressure gage for fluids (except steam).
K. Install valve and syphon fitting in piping for each pressure gage for steam.
L. Install test plugs in piping tees.
M. Install flow indicators in piping systems in accessible positions for easy viewing.
N. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters according to manufacturer's written instructions.
O. Install flowmeter elements in accessible positions in piping systems.
P. Install wafer-orifice flowmeter elements between pipe flanges.

Q. Install differential-pressure-type flowmeter elements, with at least minimum straight lengths of pipe, upstream and downstream from element according to manufacturer's written instructions.

R. Install permanent indicators on walls or brackets in accessible and readable positions.

S. Install connection fittings in accessible locations for attachment to portable indicators.

T. Mount thermal-energy meters on wall if accessible; if not, provide brackets to support meters.

U. Install thermometers in the following locations:
   1. Inlet and outlet of each hydronic coil in air-handling units.

V. Install pressure gages in the following locations:
   1. Discharge of each pressure-reducing valve.

3.2 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow space for service and maintenance of meters, gages, machines, and equipment.

B. Connect flowmeter-system elements to meters.

C. Connect flowmeter transmitters to meters.

D. Connect thermal-energy meter transmitters to meters.

3.3 ADJUSTING

A. After installation, calibrate meters according to manufacturer's written instructions.

B. Adjust faces of meters and gages to proper angle for best visibility.

3.4 THERMOMETER SCHEDULE

A. Thermometers at inlet and outlet of each hydronic coil in air-handling units and built-up central systems shall be the following:
   1. Direct mounted, light-activated.

B. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Chilled-Water Piping: 0 to 100 deg F.
B. Scale Range for Heating, Hot-Water Piping: 0 to 250 deg F.

3.6 PRESSURE-GAGE SCHEDULE

A. Pressure gages at discharge of each pressure-reducing valve shall be the following:
   
   1. Liquid-filled, direct-mounted, metal case.

3.7 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Chilled-Water Piping: 0 to 100 psi.
B. Scale Range for Heating, Hot-Water Piping: 0 to 160 psi.

3.8 FLOWMETER SCHEDULE

A. Flowmeters for Chilled-Water Piping: Turbine type.
B. Flowmeters for Heating, Hot-Water Piping: Turbine type.

END OF SECTION 230519
SECTION 230523.12 - BALL VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Bronze ball valves.
   2. Iron ball valves.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of valve.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:
   1. ASME B1.20.1 for threads for threaded-end valves.
   2. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
   4. ASME B31.1 for power piping valves.
   5. ASME B31.9 for building services piping valves.

C. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

D. Refer to HVAC valve schedule articles for applications of valves.

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

F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. Valve Actuator Types:
   1. Handlever: For quarter-turn valves smaller than NPS 4.

H. Valves in Insulated Piping:
1. Include 2-inch stem extensions.
2. Extended operating handle of nonthermal-conductive material, and protective sleeves that allow operation of valves without breaking the vapor seals or disturbing insulation.
3. Memory stops that are fully adjustable after insulation is applied.

I. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE BALL VALVES

A. Bronze Ball Valves, Two-Piece with Full Port and Bronze or Brass Trim, Threaded Ends:

1. Description:
   b. SWP Rating: 150 psig.
   c. CWP Rating: 600 psig.
   d. Body Design: Two piece.
   e. Body Material: Bronze.
   f. Ends: Threaded.
   g. Seats: PTFE.
   h. Stem: Bronze.
   i. Ball: Chrome-plated brass.
   j. Port: Full.

2.3 IRON BALL VALVES

A. Iron Ball Valves, Class 125:

1. Description:
   b. CWP Rating: 200 psig.
   d. Body Material: ASTM A126, gray iron.
   e. Ends: Flanged.
   f. Seats: PTFE.
   g. Stem: Stainless steel.
   h. Ball: Stainless steel.
   i. Port: Full.

PART 3 - EXECUTION

3.1 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
B. Locate valves for easy access and provide separate support where necessary.

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

D. Install valves in position to allow full stem movement.

3.2 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valves with specified SWP classes or CWP ratings are unavailable, the same types of valves with higher SWP classes or CWP ratings may be substituted.

B. Select valves with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends.
2. For Steel Piping, NPS 2: Flanged ends.

3.3 CHILLED-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller: Bronze ball valves, two piece, with brass or bronze trim, full port, threaded-joint ends.

1. Valves may be provided with solder-joint ends instead of threaded ends.

B. Pipe NPS 2-1/2 and Larger: Iron ball valves, Class 125.

3.4 HEATING-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller: Bronze ball valves, two piece, with brass or bronze trim, and full port.

END OF SECTION 230523.12
SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal-hanger shield inserts.
4. Equipment supports.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 233113 "Metal Ducts" for duct hangers and supports.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:

1. Trapeze pipe hangers.
2. Equipment supports.
3. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria. Include design calculations for designing trapeze hangers.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.4 QUALITY ASSURANCE

A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code, Section IX.
PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

2.2 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized, hot-dip galvanized, or electro-galvanized.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.

B. Copper Pipe and Tube Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-plated steel, factory-fabricated components.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.4 THERMAL-HANGER SHIELD INSERTS

A. Insulation-Insert Material for Cold Piping: ASTM C552, Type II cellular glass with 100-psi or ASTM C591, Type VI, Grade 1 polyisocyanurate with 125-psi minimum compressive strength and vapor barrier.

B. Insulation-Insert Material for Hot Piping: Water-repellent-treated, ASTM C533, Type I calcium silicate with 100-psi minimum compressive strength.

C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.5 FASTENER SYSTEMS

A. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.6 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.7 MATERIALS

A. Aluminum: ASTM B221.

B. Carbon Steel: ASTM A1011/A1011M.

C. Structural Steel: ASTM A36/A36M, carbon-steel plates, shapes, and bars; black and galvanized.

D. Stainless Steel: ASTM A240/A240M.

E. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
3.2 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A36/A36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

B. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

C. Fastener System Installation:

1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

D. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.

E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.


G. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

H. Install lateral bracing with pipe hangers and supports to prevent swaying.

I. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

J. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

L. Insulated Piping:

1. Attach clamps and spacers to piping.
a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
b. NPS 4: 12 inches long and 0.06 inch thick.
c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.

6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.6 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780/A780M.

3.7 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use carbon-steel pipe hangers and supports metal trapeze pipe hangers and metal framing systems and attachments for general service applications.

E. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.

F. Use padded hangers for piping that is subject to scratching.
G. Use thermal-hanger shield inserts for insulated piping and tubing.

H. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is unnecessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is unnecessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

I. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

J. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

K. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

   a. Light (MSS Type 31): 750 lb.
   b. Medium (MSS Type 32): 1500 lb.
   c. Heavy (MSS Type 33): 3000 lb.
13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

L. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

M. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
   a. Horizontal (MSS Type 54): Mounted horizontally.
   b. Vertical (MSS Type 55): Mounted vertically.
   c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

N. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

O. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 230529
SECTION 230548 - VIBRATION AND SEISMIC CONTROLS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Spring hangers.
2. Anchor bolts.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Delegated-Design Submittal: For each vibration isolation and seismic-restraint device.

1. Include design calculations and details for selecting vibration isolators and seismic restraints complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are unavailable, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.
PART 2 - PRODUCTS

2.1 RESILIENT PIPE GUIDES

A. Description: Spider-type guide sized to accommodate pipe and insulation. Material shall be selected for capability with piping. Provide dielectric separation between dissimilar metals.

2.2 SPRING HANGERS

A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Kinetics Noise Control, Inc.
   b. Mason Industries, Inc.

2. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.

3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

4. Minimum Additional Travel: 50 percent of the required deflection at rated load.

5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

7. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.

8. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.

9. Self-centering hanger-rod cap to ensure concentricity between hanger rod and support spring coil.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Strength of Support Assemblies: Where not indicated, select sizes of components so strength is adequate to carry present and future static loads within specified loading limits.
3.2 VIBRATION CONTROL DEVICE INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."

B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

3.3 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

END OF SECTION 230548
SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Duct labels.
5. Valve tags.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters 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.

B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and
title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: Yellow.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters 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.

I. Label Content: Include caution and warning information plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction according to ASME A13.1.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.

2. Lettering Size: Size letters according to ASME A13.1 for piping.
2.4 DUCT LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: White.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.

G. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

H. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings; also include duct size and an arrow indicating flow direction.

1. 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.

2.5 VALVE TAGS

A. Description: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass beaded chain or S-hook.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch 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.

1. Valve-tag schedule shall be included in operation and maintenance data.
PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.

B. Pipe Label Color Schedule:

2. Condenser-Water Piping: Yellow.
3. Heating Water Piping: Black letters on a safety-orange background.

3.4 DUCT LABEL INSTALLATION

A. Install self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:

1. Blue: For cold-air and hot-air supply ducts.
2. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
B. Locate labels near points where ducts enter into and exit from concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.5 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, and shape, and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:
   a. Chilled Water: 2 inches, round, CHW caption.
   b. Heating Water: 2 inches, round, HW caption.

END OF SECTION 230553
SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Balancing Air Systems:
   a. Variable-air-volume systems.

2. Balancing Hydronic Piping Systems:
   a. Variable-flow hydronic systems.
   b. System to be balanced:
      1) AHU-5 system
      2) AHU-2 system, including existing AHU, terminal units, and diffusers.
      3) EF-1 system
      4) Radiant panel heaters
      5) Cabinet unit heaters

1.2 DEFINITIONS


C. TAB: Testing, adjusting, and balancing.

D. TABB: Testing, Adjusting, and Balancing Bureau.

E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.

F. TDH: Total dynamic head.

1.3 ACTION SUBMITTALS

A. TAB Report: Documentation indicating that Work complies with ASHRAE/IES 90.1, Section 6.7.2.3 - "System Balancing."

1.4 INFORMATIONAL SUBMITTALS

B. Certified TAB reports.

1.5 QUALITY ASSURANCE

A. TAB Specialists Qualifications: Certified by AABC.

1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC.
2. TAB Technician: Employee of the TAB specialist and certified by AABC as a TAB technician.

B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

C. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.7.2.3 - "System Balancing."

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.

B. Examine installed systems for balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.

F. Examine equipment performance data including fan and pump curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in
AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

H. Examine test reports specified in individual system and equipment Sections.

I. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.

J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

K. Examine strainers. Verify that startup screens have been replaced by permanent screens with indicated perforations.

L. Examine control valves for proper installation for their intended function of throttling, diverting, or mixing fluid flows.

M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

N. Examine system pumps to ensure absence of entrained air in the suction piping.

O. Examine operating safety interlocks and controls on HVAC equipment.

P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures for balancing the systems.

B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:

1. Airside:
   a. Duct systems are complete with terminals installed.
   b. Volume, smoke, and fire dampers are open and functional.
   c. Clean filters are installed.
   d. Fans are operating, free of vibration, and rotating in correct direction.
   e. Variable-frequency controllers' startup is complete and safeties are verified.
   f. Automatic temperature-control systems are operational.
   g. Ceilings are installed.
   h. Windows and doors are installed.
   i. Suitable access to balancing devices and equipment is provided.
2. Hydronics:
   a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed.
   b. Piping is complete with terminals installed.
   c. Water treatment is complete.
   d. Systems are flushed, filled, and air purged.
   e. Strainers are pulled and cleaned.
   f. Control valves are functioning per the sequence of operation.
   g. Shutoff and balance valves have been verified to be 100 percent open.
   h. Pumps are started and proper rotation is verified.
   i. Pump gage connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
   j. Variable-frequency controllers' startup is complete and safeties are verified.
   k. Suitable access to balancing devices and equipment is provided.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" and in this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with removable plastic plugs.
2. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 233300 "Air Duct Accessories."
3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 "Duct Insulation," and Section 230719 "HVAC Piping Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross-check the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling-unit components.

L. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."

3.5 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Adjust the variable-air-volume systems as follows:

1. Verify that the system static pressure sensor is located two-thirds of the distance down the duct from the fan discharge.

2. Verify that the system is under static pressure control.

3. Select the terminal unit that is most critical to the supply-fan airflow. Measure inlet static pressure, and adjust system static pressure control set point so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.

4. Calibrate and balance each terminal unit for maximum and minimum design airflow as follows:

   a. Adjust controls so that terminal is calling for maximum airflow. Some controllers require starting with minimum airflow. Verify calibration procedure for specific project.

   b. Measure airflow and adjust calibration factor as required for design maximum airflow. Record calibration factor.

   c. When maximum airflow is correct, balance the air outlets downstream from terminal units.

   d. Adjust controls so that terminal is calling for minimum airflow.

   e. Measure airflow and adjust calibration factor as required for design minimum airflow. Record calibration factor. If no minimum calibration is available, note any deviation from design airflow.

   f. When in full cooling or full heating, ensure that there is no mixing of hot-deck and cold-deck airstreams unless so designed.

   g. On constant volume terminals, in critical areas where room pressure is to be maintained, verify that the airflow remains constant over the full range of full cooling to full heating. Note any deviation from design airflow or room pressure.
5. After terminals have been calibrated and balanced, test and adjust system for total airflow. Adjust fans to deliver total design airflows within the maximum allowable fan speed listed by fan manufacturer.
   a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
   b. Set terminals for maximum airflow. If system design includes diversity, adjust terminals for maximum and minimum airflow so that connected total matches fan selection and simulates actual load in the building.
   c. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
   d. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
   e. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.

6. Measure fan static pressures as follows:
   a. Measure static pressure directly at the fan outlet or through the flexible connection.
   b. Measure static pressure directly at the fan inlet or through the flexible connection.
   c. Measure static pressure across each component that makes up the air-handling system.
   d. Report any artificial loading of filters at the time static pressures are measured.

7. Set final return and outside airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
   a. Balance the return-air ducts and inlets the same as described for constant-volume air systems.
   b. Verify that terminal units are meeting design airflow under system maximum flow.

8. Re-measure the inlet static pressure at the most critical terminal unit and adjust the system static pressure set point to the most energy-efficient set point to maintain the optimum system static pressure. Record set point and give to controls contractor.

9. Verify final system conditions as follows:
   a. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to match design if necessary.
   b. Re-measure and confirm that total airflow is within design.
   c. Re-measure final fan operating data, rpms, volts, amps, and static profile.
   d. Mark final settings.
   e. Test system in economizer mode. Verify proper operation and adjust if necessary. Measure and record all operating data.
   f. Verify tracking between supply and return fans.

3.6 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports for pumps, coils, and heat exchangers. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required coil and heat exchanger flow rates with pump design flow rate.
B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. In addition to requirements in "Preparation" Article, prepare hydronic systems for testing and balancing as follows:

1. Check liquid level in expansion tank.
2. Check highest vent for adequate pressure.
3. Check flow-control valves for proper position.
4. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
5. Verify that motor starters are equipped with properly sized thermal protection.
6. Check that air has been purged from the system.

3.7 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals, and proceed as specified above for hydronic systems.

B. Adjust the variable-flow hydronic system as follows:

1. Verify that the differential-pressure sensor is located as indicated.
2. Determine whether there is diversity in the system.

C. For systems with no diversity:

1. Adjust pumps to deliver total design gpm.
   a. Measure total water flow.
      1) Position valves for full flow through coils.
      2) Measure flow by main flow meter, if installed.
      3) If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.
   b. Measure pump TDH as follows:
      1) Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
      2) Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
      3) Convert pressure to head and correct for differences in gage heights.
      4) Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
      5) With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.
2. Adjust flow-measuring devices installed in mains and branches to design water flows.
   a. Measure flow in main and branch pipes.
   b. Adjust main and branch balance valves for design flow.
   c. Re-measure each main and branch after all have been adjusted.

3. Adjust flow-measuring devices installed at terminals for each space to design water flows.
   a. Measure flow at terminals.
   b. Adjust each terminal to design flow.
   c. Re-measure each terminal after it is adjusted.
   d. Position control valves to bypass the coil and adjust the bypass valve to maintain design flow.
   e. Perform temperature tests after flows have been balanced.

4. Prior to verifying final system conditions, determine the system differential-pressure set point.

5. If the pump discharge valve was used to set total system flow with variable-frequency controller at 60 Hz, at completion open discharge valve 100 percent and allow variable-frequency controller to control system differential-pressure set point. Record pump data under both conditions.

6. Mark final settings and verify that all memory stops have been set.

7. Verify final system conditions as follows:
   a. Re-measure and confirm that total water flow is within design.
   b. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
   c. Mark final settings.

8. Verify that memory stops have been set.

3.8 TOLERANCES

A. Set HVAC system's airflow rates and water flow rates within the following tolerances:
   1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
   2. Air Outlets and Inlets: Plus or minus 10 percent.
   3. Heating-Water Flow Rate: Plus or minus 10 percent.
   4. Cooling-Water Flow Rate: Plus or minus 10 percent.

B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.9 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
1. Include a certification sheet at the front of the report's binder, signed and sealed by the
certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.
3. Certify validity and accuracy of field data.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance; do not include Shop Drawings and
   Product Data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB specialist.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report.
    Number each page in the report.
11. Summary of contents including the following:
    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract
       Documents.

12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:
    a. Settings for outdoor-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Face and bypass damper settings at coils.
    e. Fan drive settings including settings and percentage of maximum pitch diameter.
    f. Inlet vane settings for variable-air-volume systems.
    g. Settings for supply-air, static-pressure controller.
    h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present
   each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.

E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data:
   a. Unit identification.
   b. Location.
   c. Make and type.
   d. Model number and unit size.
   e. Manufacturer's serial number.
   f. Unit arrangement and class.
   g. Discharge arrangement.
   h. Sheave make, size in inches, and bore.
   i. Center-to-center dimensions of sheave and amount of adjustments in inches.
   j. Number, make, and size of belts.
   k. Number, type, and size of filters.

2. Motor Data:
   a. Motor make, and frame type and size.
   b. Horsepower and rpm.
   c. Volts, phase, and hertz.
   d. Full-load amperage and service factor.
   e. Sheave make, size in inches, and bore.
   f. Center-to-center dimensions of sheave and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):
   a. Total airflow rate in cfm.
   b. Total system static pressure in inches wg.
   c. Fan rpm.
   d. Discharge static pressure in inches wg.
   e. Filter static-pressure differential in inches wg.
   f. Preheat-coil static-pressure differential in inches wg.
   g. Cooling-coil static-pressure differential in inches wg.
   h. Outdoor airflow in cfm.
   i. Return airflow in cfm.
   j. Outdoor-air damper position.
   k. Return-air damper position.

F. Air-Handling-Unit-Coil Test Reports:

1. Coil Data:
a. System identification.
b. Location.
c. Coil type.
d. Number of rows.
e. Fin spacing in fins per inch o.c.
f. Make and model number.
g. Face area in sq. ft.
h. Tube size in NPS.
i. Tube and fin materials.
j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):
   a. Airflow rate in cfm.
b. Average face velocity in fpm.
c. Air pressure drop in inches wg.
d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
e. Return-air, wet- and dry-bulb temperatures in deg F.
f. Entering-air, wet- and dry-bulb temperatures in deg F.
g. Leaving-air, wet- and dry-bulb temperatures in deg F.
h. Water flow rate in gpm.
i. Water pressure differential in feet of head or psig.
j. Entering-water temperature in deg F.
k. Leaving-water temperature in deg F.

G. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:
   a. System and air-handling-unit number.
b. Location and zone.
c. Traverse air temperature in deg F.
d. Duct static pressure in inches wg.
e. Duct size in inches.
f. Duct area in sq. ft.
g. Indicated airflow rate in cfm.
h. Indicated velocity in fpm.
i. Actual airflow rate in cfm.
j. Actual average velocity in fpm.
k. Barometric pressure in psig.

H. Air-Terminal-Device Reports:

1. Unit Data:
   a. System and air-handling unit identification.
b. Location and zone.
c. Apparatus used for test.
d. Area served.
e. Make.
f. Number from system diagram.
g. Type and model number.
h. Size.
i. Effective area in sq. ft..

2. Test Data (Indicated and Actual Values):
   a. Airflow rate in cfm.
   b. Air velocity in fpm.
   c. Preliminary airflow rate as needed in cfm.
   d. Preliminary velocity as needed in fpm.
   e. Final airflow rate in cfm.
   f. Final velocity in fpm.
   g. Space temperature in deg F.

I. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:
   1. Unit Data:
      a. System and air-handling-unit identification.
      b. Location and zone.
      c. Room or riser served.
      d. Coil make and size.
      e. Flowmeter type.
   2. Test Data (Indicated and Actual Values):
      a. Airflow rate in cfm.
      b. Entering-water temperature in deg F.
      c. Leaving-water temperature in deg F.
      d. Water pressure drop in feet of head or psig.
      e. Entering-air temperature in deg F.
      f. Leaving-air temperature in deg F.

J. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:
   1. Unit Data:
      a. Unit identification.
      b. Location.
      c. Service.
      d. Make and size.
      e. Model number and serial number.
      f. Water flow rate in gpm.
      g. Water pressure differential in feet of head or psig.
      h. Required net positive suction head in feet of head or psig.
      i. Pump rpm.
      j. Impeller diameter in inches.
      k. Motor make and frame size.
      l. Motor horsepower and rpm.
m. Voltage at each connection.

n. Amperage for each phase.

o. Full-load amperage and service factor.

p. Seal type.

2. Test Data (Indicated and Actual Values):

a. Static head in feet of head or psig.

b. Pump shutoff pressure in feet of head or psig.

c. Actual impeller size in inches.

d. Full-open flow rate in gpm.

e. Full-open pressure in feet of head or psig.

f. Final discharge pressure in feet of head or psig.

g. Final suction pressure in feet of head or psig.

h. Final total pressure in feet of head or psig.

i. Final water flow rate in gpm.

j. Voltage at each connection.

k. Amperage for each phase.

K. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.

b. Serial number.

c. Application.

d. Dates of use.

e. Dates of calibration.

3.10 VERIFICATION OF TAB REPORT

A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Owner.

B. Owner shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.

C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."

D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

E. If TAB work fails, proceed as follows:

1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
2. If the second final inspection also fails, Owner may contract the services of another TAB specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.

3. If the second verification also fails, Owner may contact AABC Headquarters regarding the AABC National Performance Guaranty.

F. Prepare test and inspection reports.

3.11 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 230593
SECTION 230713 - DUCT INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes insulating the following duct services:
   1. Indoor, concealed supply and outdoor air.
   2. Indoor, exposed supply and outdoor air.

B. Related Sections:
   1. Section 230716 "HVAC Equipment Insulation."
   2. Section 230719 "HVAC Piping Insulation."
   3. Section 233113 "Metal Ducts" for duct liners.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
   2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
   3. Detail application of field-applied jackets.
   4. Detail application at linkages of control devices.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
   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.
PART 2 - PRODUCTS

2.1 INSULATION MATERIALS


B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C553, Type II and ASTM C1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

G. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 ADHESIVES

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

B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.


D. PVC Jacket Adhesive: Compatible with PVC jacket.

2.3 MASTICS AND COATINGS

A. Materials shall be compatible with insulation materials, jackets, and substrates.

B. Vapor-Retarder Mastic: Water based; suitable for indoor use on below ambient services.

1. Water-Vapor Permeance: Comply with ASTM C755, Section 7.2.2, Table 2, for insulation type and service conditions.
2. Service Temperature Range: Minus 20 to plus 180 deg F.
3. Comply with MIL-PRF-19565C, Type II, for permeance requirements.

2.4 SEALANTS
A. FSK and Metal Jacket Flashing Sealants:
   1. Materials shall be compatible with insulation materials, jackets, and substrates.
   2. Fire- and water-resistant, flexible, elastomeric sealant.
   3. Service Temperature Range: Minus 40 to plus 250 deg F.

2.5 FACTORY-APPLIED JACKETS
A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
   1. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.

2.6 FIELD-APPLIED JACKETS
A. Field-applied jackets shall comply with ASTM C921, Type I, unless otherwise indicated.
B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

2.7 TAPES
A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.
   1. Width: 3 inches.
   2. Thickness: 6.5 mils.
   4. Elongation: 2 percent.
   5. Tensile Strength: 40 lbf/inch in width.
   6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
B. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
   1. Width: 2 inches.
   2. Thickness: 3.7 mils.
   3. Adhesion: 100 ounces force/inch in width.
   4. Elongation: 5 percent.
   5. Tensile Strength: 34 lbf/inch in width.
2.8 SECUREMENTS

A. Aluminum Bands: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing seal or closed seal.

B. Insulation Pins and Hangers:

1. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

   a. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
   b. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
   c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

   a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

3. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

D. Wire: 0.062-inch soft-annealed, galvanized steel.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.
B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
   1. Install insulation continuously through hangers and around anchor attachments.
   2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
   3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Install insulation with factory-applied jackets as follows:
   1. Draw jacket tight and smooth.
   2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
   3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
      a. For below ambient services, apply vapor-barrier mastic over staples.
   4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
   5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.

L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.3 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
   4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
   4. Seal jacket to wall flashing with flashing sealant.

C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.

E. Insulation Installation at Floor Penetrations:
   1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
   2. Seal penetrations through fire-rated assemblies.
3.4 INSTALLATION OF MINERAL-FIBER INSULATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
   a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
   b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
   c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
   d. Do not overcompress insulation during installation.
   e. Impale insulation over pins and attach speed washers.
   f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
   a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
   b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.

2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.

3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
   a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
   b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
   c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
   d. Do not overcompress insulation during installation.
   e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
   a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
   b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.

6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.5 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

B. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.6 FIRE-RATED INSULATION SYSTEM INSTALLATION

A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.

B. Insulate duct access panels and doors to achieve same fire rating as duct.

C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Section 078413 "Penetration Firestopping."

3.7 FINISHES

A. Insulation with ASJ or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.


B. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

C. Do not field paint aluminum or stainless-steel jackets.

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location for each duct system defined in the "Duct Insulation Schedule, General" Article.
C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.9 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:
   1. Indoor, concealed supply and outdoor air.
   2. Indoor, exposed supply and outdoor air.

B. Items Not Insulated:
   1. Flexible connectors.
   2. Vibration-control devices.
   3. Factory-insulated access panels and doors.

3.10 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, Supply-Air Duct and Plenum Insulation: Mineral-fiber blanket or board, 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density.

B. Concealed, Outdoor-Air Duct and Plenum Insulation: Mineral-fiber blanket or board, 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density.

C. Exposed, Supply-Air Duct and Plenum Insulation: Mineral-fiber blanket or board, 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density.

D. Exposed, Outdoor-Air Duct and Plenum Insulation: Mineral-fiber blanket or board, 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density.

END OF SECTION 230713
SECTION 230719 - HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY
   A. Section includes insulation for HVAC piping systems.
   B. Related Sections:
      1. Section 230713 "Duct Insulation" for duct insulation.
      2. Section 230716 "HVAC Equipment Insulation" for equipment insulation.

1.2 ACTION SUBMITTALS
   A. Product Data: For each type of product.
   B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
      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.
      6. Detail application of field-applied jackets.
      7. Detail application at linkages of control devices.

1.3 INFORMATIONAL SUBMITTALS
   A. Qualification Data: For qualified Installer.
   B. Material test reports.
   C. Field quality-control reports.

1.4 QUALITY ASSURANCE
   A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
   B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities.
having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

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.

1.5 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

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

C. Coordinate installation and testing of heat tracing.

1.6 SCHEDULING

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

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

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS


B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come into contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable in accordance with ASTM C795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
F. Mineral-Fiber, Preformed Pipe: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C547.
   1. Preformed Pipe Insulation: Type I, Grade A with factory-applied ASJ.
   2. 850 deg F (454 deg C).

2.2 ADHESIVES
A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

2.3 MASTICS AND COATINGS
A. Materials shall be compatible with insulation materials, jackets, and substrates. Comply with MIL-PRF-19565C, Type II.
   1. VOC Content: 300 g/L or less
B. Vapor-Retarder Mastic, Water Based: Suitable for indoor use on below-ambient services.
   1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
   2. Service Temperature Range: 0 to plus 180 deg F.
   3. Comply with MIL-PRF-19565C, Type II, for permeance requirements.
C. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
   1. Water-Vapor Permeance: ASTM E96/E96M, greater than 1.0 perm at manufacturer's recommended dry film thickness.
   2. Service Temperature Range: 0 to plus 180 deg F.

2.4 SEALANTS
A. Materials shall be as recommended by the insulation manufacturer and shall be compatible with insulation materials, jackets, and substrates.
B. Joint Sealants:
   1. Permanently flexible, elastomeric sealant.
      a. Service Temperature Range: Minus 100 to plus 300 deg F.
      b. Color: White or gray.
C. ASJ Flashing Sealants and PVDC and PVC Jacket Flashing Sealants:
   1. Fire- and water-resistant, flexible, elastomeric sealant.
2. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).

2.5 FACTORY-APPLIED JACKETS
   A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
      1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.

2.6 FIELD-APPLIED JACKETS
   A. Field-applied jackets shall comply with ASTM C1136, Type I, unless otherwise indicated.
   B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
      1. Color: Color-code jackets based on system. Color as noted in article “Indoor Field-Applied Jacket Schedule”.

2.7 TAPES
   A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
      1. Width: 3 inches (75 mm).
      2. Thickness: 11.5 mils (0.29 mm).
      3. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
      4. Elongation: 2 percent.
      5. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
      6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
   B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
      1. Width: 2 inches (50 mm).
      2. Thickness: 6 mils (0.15 mm).
      3. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
      4. Elongation: 500 percent.
      5. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.

2.8 SECUREMENTS
   A. Staples: Outward-clinching insulation staples, nominal 3/4 inch wide, stainless steel or Monel.
PART 3 - EXECUTION

3.1 PREPARATION

A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
   1. Carbon Steel: Coat carbon steel operating at a service temperature of between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the tradesman installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of pipe system, as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
1. Install insulation continuously through hangers and around anchor attachments.

2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends attached to structure with vapor-barrier mastic.

3. Install insert materials and insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward-clinching staples along edge at 2 inches o.c.

   a. For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 25 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches in similar fashion to butt joints.

P. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.

3.3 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
   4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
   1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:
   1. Pipe: Install insulation continuously through floor penetrations.
   2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.4 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials, except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:
   1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as that of adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.

3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as that used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.

4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.

5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers, so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.

6. Insulate flanges, mechanical couplings, and unions using a section of oversized preformed pipe insulation to fit. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.

7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.

8. For services not specified to receive a field-applied jacket, except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing, using PVC tape.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as that of adjoining pipe insulation.

2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least 2 times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.5 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:
   1. Secure each layer of preformed pipe insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
   2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
   3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
   4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:
   1. Install preformed pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
   3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
   4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:
   1. Install preformed sections of same material as that of straight segments of pipe insulation when available.
   2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:
   1. Install preformed sections of same material as that of straight segments of pipe insulation when available.
   2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.6 FIELD-APPLIED JACKET INSTALLATION

A. Where PVC jackets are indicated and for horizontal applications, install with 1-inch (25-mm) overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections.
B. Tests and Inspections: Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
C. All insulation applications will be considered defective if they do not pass tests and inspections.
D. Prepare test and inspection reports.

3.8 PIPING INSULATION SCHEDULE, GENERAL

A. Insulation conductivity and thickness per pipe size shall comply with schedules in this Section or with requirements of authorities having jurisdiction, whichever is more stringent.
B. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

3.9 INDOOR PIPING INSULATION SCHEDULE

A. Condensate and Equipment Drain Water below 60 Deg F (16 Deg C):
   1. All Pipe Sizes: Insulation shall be the following:
      a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch (13 mm) thick.
B. Chilled Water and Brine, Above 40 Deg F:
   1. NPS 12 and Smaller: Insulation shall be one of the following:
      a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
C. Heating-Hot-Water Supply and Return, 200 Deg F and Below:
   1. NPS 12 and Smaller: Insulation shall be the following:
      a. Mineral-Fiber, Preformed Pipe, Type I: 2 inches thick.

3.10 INDOOR, FIELD-APPLIED JACKET SCHEDULE

   A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

   B. If more than one material is listed, selection from materials listed is Contractor's option.

   C. Piping, Concealed:
      1. PVC, Color-Coded by System: 20 mils (0.5 mm) thick.

   D. Piping, Exposed:
      1. PVC, Color-Coded by System: 20 mils (0.5 mm) thick.

   E. Field-Applied Jacket Colors shall match the Owner’s standard, as listed below:
      1. Chilled water - green.
      3. Storm (AC condensate) - white.

END OF SECTION 230719
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. DDC system for monitoring and controlling of HVAC systems.
   2. Delivery of selected control devices to equipment and systems manufacturers for factory installation and to HVAC systems installers for field installation.

B. Related Requirements:
   1. Section 230923.22 "Position Instruments" for limit switches that connect to DDC systems.
   2. Section 230923.33 "Vibration Instruments" for vibration instruments that connect to DDC systems.
   3. Communications Cabling:
      b. Section 271513 "Communications Copper Horizontal Cabling" for balanced twisted pair communications cable.
      c. Section 271523 "Communications Optical Fiber Backbone Cabling" for optical fiber communications cable.
   4. Raceways:
      a. Section 260533 "Raceways and Boxes for Electrical Systems" for raceways for low-voltage control cable.
      b. Section 270528 "Pathways for Communications Systems" for raceways for balanced twisted pair cabling and optical fiber cable.

1.2 DEFINITIONS

A. Algorithm: A logical procedure for solving a recurrent mathematical problem. A prescribed set of well-defined rules or processes for solving a problem in a finite number of steps.

B. Analog: A continuously varying signal value, such as current, flow, pressure, or temperature.

C. BACnet Specific Definitions:
2. BACnet Interoperability Building Blocks (BIBBs): BIBB defines a small portion of BACnet functionality that is needed to perform a particular task. BIBBs are combined to build the BACnet functional requirements for a device.

3. BACnet/IP: Defines and allows using a reserved UDP socket to transmit BACnet messages over IP networks. A BACnet/IP network is a collection of one or more IP subnetworks that share the same BACnet network number.


5. PICS (Protocol Implementation Conformance Statement): Written document that identifies the particular options specified by BACnet that are implemented in a device.

D. Binary: Two-state signal where a high signal level represents "ON" or "OPEN" condition and a low signal level represents "OFF" or "CLOSED" condition. "Digital" is sometimes used interchangeably with "Binary" to indicate a two-state signal.

E. Controller: Generic term for any standalone, microprocessor-based, digital controller residing on a network, used for local or global control. Three types of controllers are indicated: Network Controller, Programmable Application Controller, and Application-Specific Controller.

F. Control System Integrator: An entity that assists in expansion of existing enterprise system and support of additional operator interfaces to I/O being added to existing enterprise system.

G. COV: Changes of value.

H. DDC System Provider: Authorized representative of, and trained by, DDC system manufacturer and responsible for execution of DDC system Work indicated.

I. Distributed Control: Processing of system data is decentralized and control decisions are made at subsystem level. System operational programs and information are provided to remote subsystems and status is reported back. On loss of communication, subsystems shall be capable of operating in a standalone mode using the last best available data.

J. DOCSIS: Data-Over Cable Service Interface Specifications.

K. Gateway: Bidirectional protocol translator that connects control systems that use different communication protocols.

L. HLC: Heavy load conditions.

M. I/O: System through which information is received and transmitted. I/O refers to analog input (AI), binary input (BI), analog output (AO) and binary output (BO). Analog signals are continuous and represent control influences such as flow, level, moisture, pressure, and temperature. Binary signals convert electronic signals to digital pulses (values) and generally represent two-position operating and alarm status. "Digital," (DI and (DO), is sometimes used interchangeably with "Binary," (BI) and (BO), respectively.

N. LAN: Local area network.

O. LNS: LonWorks Network Services.
P. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

Q. Mobile Device: A data-enabled phone or tablet computer capable of connecting to a cellular data network and running a native control application or accessing a web interface.


S. MS/TP: Master-slave/token-passing, IEE 8802-3. Datalink protocol LAN option that uses twisted-pair wire for low-speed communication.

T. Network Controller: Digital controller, which supports a family of programmable application controllers and application-specific controllers, that communicates on peer-to-peer network for transmission of global data.

U. Network Repeater: Device that receives data packet from one network and rebroadcasts it to another network. No routing information is added to protocol.

V. Peer to Peer: Networking architecture that treats all network stations as equal partners.

W. POT: Portable operator's terminal.

X. RAM: Random access memory.

Y. RF: Radio frequency.

Z. Router: Device connecting two or more networks at network layer.

AA. TCP/IP: Transport control protocol/Internet protocol.

BB. UPS: Uninterruptible power supply.

CC. USB: Universal Serial Bus.

DD. User Datagram Protocol (UDP): This protocol assumes that the IP is used as the underlying protocol.

EE. VAV: Variable air volume.

FF. WLED: White light emitting diode.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product include the following:
1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
4. Installation, operation and maintenance instructions including factors effecting performance.
5. Bill of materials of indicating quantity, manufacturer, and extended model number for each unique product.
   a. DDC controllers.
   b. Enclosures.
   c. Electrical power devices.
   d. Accessory devices.
   e. Accessories.
   f. Control dampers and actuators.
   g. Control valves and actuators.
6. When manufacturer's product datasheets apply to a product series rather than a specific product model, clearly indicate and highlight only applicable information.
7. Each submitted piece of product literature shall clearly cross reference specification and drawings that submittal is to cover.

B. Shop Drawings:

1. Include plans, elevations, sections, and mounting details where applicable.
2. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Detail means of vibration isolation and show attachments to rotating equipment.
4. Plan Drawings indicating the following:
   a. Screened backgrounds of walls, structural grid lines, HVAC equipment, ductwork and piping.
   b. Room names and numbers with coordinated placement to avoid interference with control products indicated.
   c. Each DDC controller, control panel instrument connecting to DDC controller, and damper and valve connecting to DDC controller, if included in Project.
   d. Exact placement of products in rooms, ducts, and piping to reflect proposed installed condition.
   e. Network communication cable and raceway routing.
   f. Proposed routing of wiring, cabling, conduit, and tubing, coordinated with building services for review before installation.
5. Schematic drawings for each controlled HVAC system indicating the following:
a. I/O points labeled with point names shown. Indicate instrument range, normal operating set points, and alarm set points. Indicate fail position of each damper and valve, if included in Project.
b. I/O listed in table format showing point name, type of device, manufacturer, model number, and cross-reference to product data sheet number.
c. A graphic showing location of control I/O in proper relationship to HVAC system.
d. Wiring diagram with each I/O point having a unique identification and indicating labels for all wiring terminals.
e. Unique identification of each I/O that shall be consistently used between different drawings showing same point.
f. Elementary wiring diagrams of controls for HVAC equipment motor circuits including interlocks, switches, relays and interface to DDC controllers.
g. Narrative sequence of operation.
h. Graphic sequence of operation, showing all inputs and output logical blocks.

6. Control panel drawings indicating the following:
a. Panel dimensions, materials, size, and location of field cable, raceways, and tubing connections.
b. Interior subpanel layout, drawn to scale and showing all internal components, cabling and wiring raceways, nameplates and allocated spare space.
c. Front, rear, and side elevations and nameplate legend.
d. Unique drawing for each panel.

7. DDC system electrical power riser diagram indicating the following:
a. Each point of connection to field power with requirements (volts/phase/hertz/amperes/connection type) listed for each.
b. Each control power supply including, as applicable, transformers, power-line conditioners, transient voltage suppression and high filter noise units, DC power supplies, and UPS units with unique identification for each.
c. Each product requiring power with requirements (volts/phase/hertz/amperes/connection type) listed for each.
d. Power wiring type and size, race type, and size for each.

8. Monitoring and control signal diagrams indicating the following:
a. Control signal cable and wiring between controllers and I/O.
b. Point-to-point schematic wiring diagrams for each product.
c. Control signal tubing to sensors, switches and transmitters.
d. Process signal tubing to sensors, switches and transmitters.

9. Color graphics indicating the following:
a. Itemized list of color graphic displays to be provided.
b. For each display screen to be provided, a true color copy showing layout of pictures, graphics and data displayed.
c. Intended operator access between related hierarchical display screens.

C. Delegated-Design Submittal: For DDC system products and installation indicated as being delegated.
1. Supporting documentation showing DDC system design complies with performance requirements indicated, including calculations and other documentation necessary to prove compliance.

2. Schedule and design calculations for control dampers and actuators.
   a. Flow at Project design and minimum flow conditions.
   b. Face velocity at Project design and minimum airflow conditions.
   c. Pressure drop across damper at Project design and minimum airflow conditions.
   d. AMCA 500-D damper installation arrangement used to calculate and schedule pressure drop, as applicable to installation.
   e. Maximum close-off pressure.
   f. Leakage airflow at maximum system pressure differential (fan close-off pressure).
   g. Torque required at worst case condition for sizing actuator.
   h. Actuator selection indicating torque provided.
   i. Actuator signal to control damper (on, close or modulate).
   j. Actuator position on loss of power.
   k. Actuator position on loss of control signal.

3. Schedule and design calculations for control valves and actuators.
   a. Flow at Project design and minimum flow conditions.
   b. Pressure differential drop across valve at Project design flow condition.
   c. Maximum system pressure-differential drop (pump close-off pressure) across valve at Project minimum flow condition.
   d. Design and minimum control valve coefficient with corresponding valve position.
   e. Maximum close-off pressure.
   f. Leakage flow at maximum system pressure differential.
   g. Torque required at worst case condition for sizing actuator.
   h. Actuator selection indicating torque provided.
   i. Actuator signal to control damper (on, close or modulate).
   j. Actuator position on loss of power.
   k. Actuator position on loss of control signal.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates:
   1. Data Communications Protocol Certificates: Certifying that each proposed DDC system component complies with ASHRAE 135.

C. Product Test Reports: For each product that requires testing to be performed by a qualified testing agency.

D. Preconstruction Test Reports: For each separate test performed.

E. Source quality-control reports.

F. Field quality-control reports.
G. Sample Warranty: For manufacturer's warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For DDC system to include in emergency, operation and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

   a. Project Record Drawings of as-built versions of submittal Shop Drawings provided in electronic PDF format.
   b. Testing and commissioning reports and checklists of completed final versions of reports, checklists, and trend logs.
   c. As-built versions of submittal Product Data.
   d. Names, addresses, e-mail addresses and 24-hour telephone numbers of Installer and service representatives for DDC system and products.
   e. Operator's manual with procedures for operating control systems including logging on and off, handling alarms, producing point reports, trending data, overriding computer control and changing set points and variables.
   f. Programming manuals with description of programming language and syntax, of statements for algorithms and calculations used, of point database creation and modification, of program creation and modification, and of editor use.
   g. Engineering, installation, and maintenance manuals that explain how to:
      
      1) Design and install new points, panels, and other hardware.
      2) Perform preventive maintenance and calibration.
      3) Debug hardware problems.
      4) Repair or replace hardware.
   
   h. Documentation of all programs created using custom programming language including set points, tuning parameters, and object database.
   i. Backup copy of graphic files, programs, and database on electronic media such as DVDs.
   j. List of recommended spare parts with part numbers and suppliers.
   k. Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware including computer equipment and sensors.
   l. Complete original-issue copies of furnished software, including operating systems, custom programming language, operator workstation software, and graphics software.
   m. Licenses, guarantees, and warranty documents.
   n. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.
   o. Owner training materials.
1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials and parts that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

B. Include product manufacturers' recommended parts lists for proper product operation over four-year period following warranty period. Parts list shall be indicated for each year.

C. Furnish parts, as indicated by manufacturer's recommended parts list, for product operation during one-year period following warranty period.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA.
   1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

B. Welding Qualifications: Qualify procedures and personnel according to the following:
   1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
   2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

C. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

1.9 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace products that fail in materials or workmanship within specified warranty period.
   1. Failures shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner.
   2. Include updates or upgrades to software and firmware if necessary to resolve deficiencies.
      a. Install updates only after receiving Owner's written authorization.
   3. Warranty service shall occur during normal business hours and commence within 24 hours of Owner's warranty service request.
   4. Warranty Period: Two year(s) from date of Substantial Completion.
PART 2 - PRODUCTS

2.1 DDC SYSTEM MANUFACTURERS

A. The system shall be Web CTRL by Automated Logic Corporation (ALC), as an extension of the existing building control system. Please contact: Brian Hamilton/Automated Logic Corporation at 717-909-7000. No substitutions will be permitted.

2.2 DDC SYSTEM DESCRIPTION

A. The existing system server and software shall be reused. Graphics shall be updated to reflect all DDC system changes under this project.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 WEB ACCESS

A. DDC system shall be web based or web compatible.

1. Web-Based Access to DDC System:

   a. DDC system software shall be based on server thin-client architecture, designed around open standards of web technology. DDC system server shall be accessed using a web browser over DDC system network, using Owner's LAN, and remotely over Internet through Owner's LAN.

   b. Intent of thin-client architecture is to provide operators complete access to DDC system via a web browser. No special software other than a web browser shall be required to access graphics, point displays, and trends; to configure trends, points, and controllers; and to edit programming.

   c. web access shall be password protected.

2.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional to design DDC system to satisfy requirements indicated.

1. System Performance Objectives:

   a. DDC system shall manage HVAC systems.

   b. DDC system control shall operate HVAC systems to achieve optimum operating costs while using least possible energy and maintaining specified performance.

   c. DDC system shall respond to power failures, HVAC equipment failures, and adverse and emergency conditions encountered through connected I/O points.

   d. DDC system shall operate while unattended by an operator and through operator interaction.
e. DDC system shall record trends and transaction of events and produce report information such as performance, energy, occupancies, and equipment operation.

B. Surface-Burning Characteristics: Products installed in ducts, equipment, and return-air paths shall comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.

C. Input Point Displayed Accuracy: Input point displayed values shall meet following end-to-end overall system accuracy, including errors associated with meter, sensor, transmitter, lead wire or cable, and analog to digital conversion.

1. Flow:
   a. Air: Within 5 percent of design flow rate.
   b. Air (Terminal Units): Within 5 percent of design flow rate.
   c. Water: Within 5 percent of design flow rate.

2. Gas:
   a. Carbon Dioxide: Within 50 ppm.

3. Moisture (Relative Humidity):
   a. Air: Within 5 percent RH.
   b. Space: Within 5 percent RH.
   c. Outdoor: Within 5 percent RH.

4. Pressure:
   a. Air, Ducts and Equipment: 1 percent of instrument span.
   b. Water: Within 1 percent of instrument span.

5. Speed: Within 5 percent of reading.

6. Temperature, Dry Bulb:
   a. Air: Within 0.5 deg F.
   b. Space: Within 0.5 deg F.
   c. Outdoor: Within 1 deg F.
   d. Chilled Water: Within 0.5 deg F.
   e. Heating Hot Water: Within 0.5 deg F.
   f. Temperature Difference: Within 0.25 deg F.

7. Temperature, Wet Bulb:
   a. Air: Within 0.5 deg F.
   b. Outdoor: Within 1 deg F.
D. Precision of I/O Reported Values: Values reported in database and displayed shall have following precision:

1. Current:
   a. Milliamperes: Nearest 1/100th of a milliampere.
   b. Amperes: Nearest 1/10th of an ampere up to 100 A; nearest ampere for 100 A and more.

2. Flow:
   a. Air: Nearest 1/10th of a cfm through 100 cfm; nearest cfm between 100 and 1000 cfm; nearest 10 cfm between 1000 and 10,000 cfm; nearest 100 cfm above 10,000 cfm.
   b. Water: Nearest 1/10th gpm through 100 gpm; nearest gpm between 100 and 1000 gpm; nearest 10 gpm between 1000 and 10,000 gpm; nearest 100 gpm above 10,000 gpm.

3. Gas:

4. Moisture (Relative Humidity):
   a. Relative Humidity (Percentage): Nearest 1 percent.

5. Speed:
   a. Rotation (rpm): Nearest 1 rpm.
   b. Velocity: Nearest 1/10th fpm through 100 fpm; nearest fpm between 100 and 1000 fpm; nearest 10 fpm above 1000 fpm.


7. Pressure:
   a. Air, Ducts and Equipment: Nearest 1/10th in. w.c.
   b. Space: Nearest 1/100th in. w.c. (Nearest 1/10th Pa).
   c. Water: Nearest 1/10 psig through 100 psig, nearest psig above 100 psig.

8. Temperature:
   a. Air, Ducts and Equipment: Nearest 1/10th of a degree.
   b. Outdoor: Nearest degree.
   c. Space: Nearest 1/10th of a degree.
   d. Chilled Water: Nearest 1/10th of a degree.
   e. Condenser Water: Nearest 1/10th of a degree.
   f. Heating Hot Water: Nearest degree.
   g. Heat Recovery Runarounds: Nearest 1/10th of a degree.
   h. Steam: Nearest degree.

9. Voltage: Nearest 1/10 volt up to 100 V; nearest volt above 100 V.
E. Control Stability: Control variables indicated within the following limits:

1. Flow:
   a. Air, Ducts and Equipment, except Terminal Units: Within 2 percent of design flow rate.
   b. Air, Terminal Units: Within 5 percent of design flow rate.
   c. Water: Within 5 percent of design flow rate.

2. Gas:
   a. Carbon Dioxide: Within 50 ppm.

3. Moisture (Relative Humidity):
   a. Air: Within 2 percent RH.

4. Pressure:
   a. Air, Ducts and Equipment: 1 percent of instrument span.
   b. Space: Within 0.5 percent of instrument span.
   c. Water: Within 0.5 percent of instrument span.

5. Temperature, Dry Bulb:
   a. Air: Within 1 deg F.
   b. Space: Within 1 deg F.
   c. Chilled Water: Within 0.5 deg F.
   d. Heating Hot Water: Within 1 deg F.

6. Temperature, Wet Bulb:
   a. Air: Within 0.5 deg F.
   b. Space: Within 1 deg F.

F. Environmental Conditions for Controllers, Gateways, and Routers:

1. Products shall operate without performance degradation under ambient environmental temperature, pressure and humidity conditions encountered for installed location.
   a. If product alone cannot comply with requirement, install product in a protective enclosure that is isolated and protected from conditions impacting performance. Enclosure shall be internally insulated, electrically heated, cooled and ventilated as required by product and application.

2. Products shall be protected with enclosures satisfying the following minimum requirements unless more stringent requirements are indicated. Products not available with integral enclosures complying with requirements indicated shall be housed in protective secondary enclosures. Installed location shall dictate the following NEMA 250 enclosure requirements:
a. Indoors, Heated with Filtered Ventilation: Type 1.
b. Indoors, Heated with Non-Filtered Ventilation: Type 12.
c. Indoors, Heated and Air Conditioned: Type 1.
d. Mechanical Equipment Rooms:
   1) Air-Moving Equipment Rooms: Type 12.
e. Within Duct Systems and Air-Moving Equipment Not Exposed to Possible Condensation: Type 12.
f. Within Duct Systems and Air-Moving Equipment Exposed to Possible Condensation: Type 4.

G. Environmental Conditions for Instruments and Actuators:

1. Instruments and actuators shall operate without performance degradation under the ambient environmental temperature, pressure, humidity, and vibration conditions specified and encountered for installed location.
   a. If instruments and actuators alone cannot comply with requirement, install instruments and actuators in protective enclosures that are isolated and protected from conditions impacting performance. Enclosure shall be internally insulated, electrically heated and ventilated as required by instrument and application.

2. Instruments, actuators and accessories shall be protected with enclosures satisfying the following minimum requirements unless more stringent requirements are indicated. Instruments and actuators not available with integral enclosures complying with requirements indicated shall be housed in protective secondary enclosures. Installed location shall dictate the following NEMA 250 enclosure requirements:
   a. Indoors, Heated with Filtered Ventilation: Type 1.
   b. Indoors, Heated with Non-Filtered Ventilation: Type 12.
   c. Indoors, Heated and Air-conditioned: Type 1.
   d. Mechanical Equipment Rooms:
      1) Air-Moving Equipment Rooms: Type 12.
   e. Within Duct Systems and Air-Moving Equipment Not Exposed to Possible Condensation: Type 12.
   f. Within Duct Systems and Air-Moving Equipment Exposed to Possible Condensation: Type 4.

H. Electric Power Quality:

1. Power-Line Surges:
   a. Protect susceptible DDC system products connected to ac power circuits from power-line surges to comply with requirements of IEEE C62.41.
   b. Do not use fuses for surge protection.
   c. Test protection in the normal mode and in the common mode, using the following two waveforms:
1) 10-by-1000-mic.sec. waveform with a peak voltage of 1500 V and a peak current of 60 A.
2) 8-by-20-mic.sec. waveform with a peak voltage of 1000 V and a peak current of 500 A.

2. Power Conditioning:
   a. Protect susceptible DDC system products connected to ac power circuits from irregularities and noise rejection. Characteristics of power-line conditioner shall be as follows:
      1) At 85 percent load, output voltage shall not deviate by more than plus or minus 1 percent of nominal when input voltage fluctuates between minus 20 percent to plus 10 percent of nominal.
      2) During load changes from zero to full load, output voltage shall not deviate by more than plus or minus 3 percent of nominal.
      3) Accomplish full correction of load switching disturbances within five cycles, and 95 percent correction within two cycles of onset of disturbance.
      4) Total harmonic distortion shall not exceed 3-1/2 percent at full load.

3. Ground Fault: Protect products from ground fault by providing suitable grounding. Products shall not fail due to ground fault condition.

I. Continuity of Operation after Electric Power Interruption:
   1. Equipment and associated factory-installed controls, field-installed controls, electrical equipment, and power supply connected to building normal and backup power systems shall automatically return equipment and associated controls to operating state occurring immediately before loss of normal power, without need for manual intervention by operator when power is restored either through backup power source or through normal power if restored before backup power is brought online.

2.5 NETWORK COMMUNICATION PROTOCOL

A. Network communication protocol(s) used throughout entire DDC system shall be open to Owner and available to other companies for use in making future modifications to DDC system.

B. ASHRAE 135 Protocol:
   1. ASHRAE 135 communication protocol shall be sole and native protocol used throughout entire DDC system.
   2. DDC system shall not require use of gateways except to integrate HVAC equipment and other building systems and equipment, not required to use ASHRAE 135 communication protocol.
   3. If used, gateways shall connect to DDC system using ASHRAE 135 communication protocol and Project object properties and read/write services indicated by interoperability schedule.
   4. Operator workstations, controllers and other network devices shall be tested and listed by BACnet Testing Laboratories.
2.6 SYSTEM SOFTWARE

A. Project-Specific Graphics: Graphics documentation including, but not limited to, the following:

1. Site plan showing each building, and additional site elements, which are being controlled or monitored by DDC system.
2. Plan for each building floor, including interstitial floors, and each roof level of each building, showing the following:
   a. Room layouts with room identification and name.
   b. Locations and identification of all monitored and controlled HVAC equipment and other equipment being monitored and controlled by DDC system.
   c. Location and identification of each hardware point being controlled or monitored by DDC system.
3. Control schematic for each of following, including a graphic system schematic representation, similar to that indicated on Drawings, with point identification, set point and dynamic value indication, sequence of operation and control logic diagram.
   a. Air-handling system and unit.
4. Graphic display for each piece of equipment connected to DDC system through a data communications link. Include dynamic indication of all points associated with equipment.

B. Standard Reports: Standard DDC system reports shall be provided and operator shall be able to customize reports later.

1. All I/O: With current status and values.
2. Alarm: All current alarms, except those in alarm lockout.
3. Disabled I/O: All I/O points that are disabled.
4. Alarm Lockout I/O: All I/O points in alarm lockout, whether manual or automatic.
5. Alarm Lockout I/O in Alarm: All I/O in alarm lockout that are currently in alarm.
6. Logs:
   a. Alarm history.
   b. System messages.
   c. System events.
   d. Trends.

C. Custom Reports: Operator shall be able to easily define any system data into a daily, weekly, monthly, or annual report. Reports shall be time and date stamped and shall contain a report title.

D. Standard Trends:

1. Trend all I/O point present values, set points, and other parameters indicated for trending.
2. Trends shall be associated into groups, and a trend report shall be set up for each group.
3. Trends shall be stored within DDC controller and uploaded to hard drives automatically on reaching 75 percent of DDC controller buffer limit, or by operator request, or by archiving time schedule.
4. Preset trend intervals for each I/O point after review with Owner.
5. Trend intervals shall be operator selectable from 10 seconds up to 60 minutes. Minimum number of consecutive trend values stored at one time shall be 100 per variable.
6. When drive storage memory is full, most recent data shall overwrite oldest data.
7. Archived and real-time trend data shall be available for viewing numerically and graphically by operators.

E. Custom Trends: Operator shall be able to define a custom trend log for any I/O point in DDC system.
   1. Each trend shall include interval, start time, and stop time.
   2. Data shall be sampled and stored on DDC controller, within storage limits of DDC controller, and then uploaded to archive on [workstation] [server] hard drives.
   3. Data shall be retrievable for use in spreadsheets and standard database programs.

2.7 DDC CONTROLLERS

A. DDC system shall consist of a combination of network controllers, programmable application controllers and application-specific controllers to satisfy performance requirements indicated.

B. DDC controllers shall perform monitoring, control, energy optimization and other requirements indicated.

C. DDC controllers shall use a multitasking, multiuser, real-time digital control microprocessor with a distributed network database and intelligence.

D. Each DDC controller shall be capable of full and complete operation as a completely independent unit and as a part of a DDC system wide distributed network.

E. Environment Requirements:
   1. Controller hardware shall be suitable for the anticipated ambient conditions.
   2. Controllers located in conditioned space shall be rated for operation at 32 to 120 deg F.

F. Power and Noise Immunity:
   1. Controller shall operate at 90 to 110 percent of nominal voltage rating and shall perform an orderly shutdown below 80 percent of nominal voltage.
   2. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios with up to 5 W of power located within 36 inches of enclosure.

G. DDC Controller Spare Processing Capacity:
   1. Include spare processing memory for each controller. RAM, PROM, or EEPROM will implement requirements indicated with the following spare memory:
      a. Programmable Application Controllers: Not less than 60 percent.
      b. Application-Specific Controllers: Not less than 70 percent.
   2. Memory shall support DDC controller's operating system and database and shall include the following:
a. Monitoring and control.
b. Energy management, operation and optimization applications.
c. Alarm management.
d. Historical trend data of all connected I/O points.
e. Maintenance applications.
f. Operator interfaces.
g. Monitoring of manual overrides.

H. DDC Controller Spare I/O Point Capacity: Include spare I/O point capacity for each controller as follows:

1. Programmable Application Controllers:
   a. 10 percent of each AI, AO, BI, and BO point connected to controller.
   b. Minimum Spare I/O Points per Controller:
      1) AIs: Two.
      2) AOs: Two.
      3) BIs: Three.
      4) BOs: Three.

2. Application-Specific Controllers:
   a. 10 percent of each AI, AO, BI, and BO point connected to controller.
   b. Minimum Spare I/O Points per Controller:
      1) AIs: One.
      2) AOs: One.
      3) BIs: One.
      4) BOs: One.

I. Maintenance and Support: Include the following features to facilitate maintenance and support:

1. Mount microprocessor components on circuit cards for ease of removal and replacement.
2. Means to quickly and easily disconnect controller from network.
3. Means to quickly and easily access connect to field test equipment.
4. Visual indication that controller electric power is on, of communication fault or trouble, and that controller is receiving and sending signals to network.

J. Input and Output Point Interface:

1. Hardwired input and output points shall connect to network, programmable application and application-specific controllers.
2. Input and output points shall be protected so shorting of point to itself, to another point, or to ground will not damage controller.
3. Input and output points shall be protected from voltage up to 24 V of any duration so that contact will not damage controller.
4. AIs:
   a. AIs shall include monitoring of low-voltage (zero- to 10-V dc), current (4 to 20 mA) and resistance signals from thermistor and RTD sensors.
b. AIs shall be compatible with, and field configurable to, sensor and transmitters installed.
c. Controller AIs shall perform analog-to-digital (A-to-D) conversion with a minimum resolution of 8 bits or better to comply with accuracy requirements indicated.
d. Signal conditioning including transient rejection shall be provided for each AI.
e. Capable of being individually calibrated for zero and span.
f. Incorporate common-mode noise rejection of at least 50 dB from zero to 100 Hz for differential inputs, and normal-mode noise rejection of at least 20 dB at 60 Hz from a source impedance of 10000 ohms.

5. AOs:
   a. Controller AOs shall perform analog-to-digital (A-to-D) conversion with a minimum resolution of 8 bits or better to comply with accuracy requirements indicated.
   b. Output signals shall have a range of 4 to 20 mA dc or zero- to 10-V dc as required to include proper control of output device.
   c. Capable of being individually calibrated for zero and span.
   d. AOs shall not exhibit a drift of greater than 0.4 percent of range per year.

6. BIs:
   a. Controller BIs shall accept contact closures and shall ignore transients of less than 5-ms duration.
   b. Isolation and protection against an applied steady-state voltage of up to 180-V ac peak.
   c. BIs shall include a wetting current of at least 12 mA to be compatible with commonly available control devices and shall be protected against effects of contact bounce and noise.
   d. BIs shall sense "dry contact" closure without external power (other than that provided by the controller) being applied.
   e. Pulse accumulation input points shall comply with all requirements of BIs and accept up to 10 pulses per second for pulse accumulation. Buffer shall be provided to totalize pulses. Pulse accumulator shall accept rates of at least 20 pulses per second. The totalized value shall be reset to zero on operator's command.

7. BOs:
   a. Controller BOs shall include relay contact closures or triac outputs for momentary and maintained operation of output devices.
      1) Relay contact closures shall have a minimum duration of 0.1 second. Relays shall include at least 180 V of isolation. Electromagnetic interference suppression shall be provided on all output lines to limit transients to non-damaging levels. Minimum contact rating shall be 1 A at 24-V ac.
      2) Triac outputs shall include at least 180 V of isolation. Minimum contact rating shall be 1 A at 24-V ac.
   b. BOs shall include for two-state operation or a pulsed low-voltage signal for pulse-width modulation control.
c. BOs shall be selectable for either normally open or normally closed operation.

d. Include tristate outputs (two coordinated BOs) for control of three-point floating-type electronic actuators without feedback.

e. Floating point control shall not be used.

2.8 PROGRAMMABLE APPLICATION CONTROLLERS

A. General Programmable Application Controller Requirements:

1. Include adequate number of controllers to achieve performance indicated.
2. Controller shall have enough memory to support its operating system, database, and programming requirements.
3. Data shall be shared between networked controllers and other network devices.
4. Operating system of controller shall manage input and output communication signals to allow distributed controllers to share real and virtual object information and allow for central monitoring and alarms.
5. Controllers shall have a real-time clock.
6. Controller shall continually check status of its processor and memory circuits. If an abnormal operation is detected, controller shall assume a predetermined failure mode and generate an alarm notification.
7. Controllers shall be fully programmable.

B. Communication:

1. Programmable application controllers shall communicate with other devices on network.

C. Operator Interface:

1. Controller shall be equipped with a service communications port for connection to a portable operator's workstation or mobile device.
2. Local Keypad and Display:
   a. Equip controller with local keypad and digital display for interrogating and editing data.
   b. Use of keypad and display shall require security password.

D. Serviceability:

1. Controller shall be equipped with diagnostic LEDs or other form of local visual indication of power, communication, and processor.
2. Wiring and cable connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
3. Controller shall maintain BIOS and programming information in event of a power loss for at least 72 hours.
2.9 APPLICATION-SPECIFIC CONTROLLERS

A. Description: Microprocessor-based controllers, which through hardware or firmware design are dedicated to control a specific piece of equipment. Controllers are not fully user-programmable but are configurable and customizable for operation of equipment they are designed to control.

1. Capable of standalone operation and shall continue to include control functions without being connected to network.
2. Data shall be shared between networked controllers and other network devices.

B. Communication: Application-specific controllers shall communicate with other application-specific controller and devices on network, and to programmable application and network controllers.

C. Operator Interface: Controller shall be equipped with a service communications port for connection to a portable operator's workstation. Connection shall extend to port on space temperature sensor that is connected to controller.

D. Serviceability:

1. Controller shall be equipped with diagnostic LEDs or other form of local visual indication of power, communication, and processor.
2. Wiring and cable connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
3. Controller shall use nonvolatile memory and maintain all BIOS and programming information in event of power loss.

2.10 CONTROLLER SOFTWARE

A. General Controller Software Requirements:

1. Software applications shall reside and operate in controllers. Editing of applications shall occur at operator workstations.
2. I/O points shall be identified by up to 30-character point name and up to 16-character point descriptor. Same names shall be used at operator workstations.
3. Control functions shall be executed within controllers using DDC algorithms.
4. Controllers shall be configured to use stored default values to ensure fail-safe operation. Default values shall be used when there is a failure of a connected input instrument or loss of communication of a global point value.

B. Security:

1. Operator access shall be secured using individual security passwords and user names.
2. Passwords shall restrict operator to points, applications, and system functions as assigned by system manager.
3. Operator log-on and log-off attempts shall be recorded.
4. System shall protect itself from unauthorized use by automatically logging off after last keystroke. The delay time shall be operator-definable.
C. Scheduling: Include capability to schedule each point or group of points in system. Each schedule shall consist of the following:

1. Weekly Schedule:
   a. Include separate schedules for each day of week.
   b. Each schedule should include the capability for start, stop, optimal start, optimal stop, and night economizer.
   c. Each schedule may consist of up to 10 events.
   d. When a group of objects are scheduled together, include capability to adjust start and stop times for each member.

2. Exception Schedules:
   a. Include ability for operator to designate any day of the year as an exception schedule.
   b. Exception schedules may be defined up to a year in advance. Once an exception schedule is executed, it will be discarded and replaced by regular schedule for that day of week.

3. Holiday Schedules:
   a. Include capability for operator to define up to 99 special or holiday schedules.
   b. Schedules may be placed on scheduling calendar and will be repeated each year.
   c. Operator shall be able to define length of each holiday period.

D. System Coordination:

1. Include standard application for proper coordination of equipment.
2. Application shall include operator with a method of grouping together equipment based on function and location.
3. Group may then be used for scheduling and other applications.

E. Binary Alarms:

1. Each binary point shall be set to alarm based on operator-specified state.
2. Include capability to automatically and manually disable alarming.

F. Analog Alarms:

1. Each analog object shall have both high and low alarm limits.
2. Alarming shall be able to be automatically and manually disabled.

G. Alarm Reporting:

1. Operator shall be able to determine action to be taken in event of an alarm.
2. Alarms shall be routed to appropriate operator workstations based on time and other conditions.
3. Alarm shall be able to start programs, print, be logged in event log, generate custom messages, and display graphics.
H. Remote Communication:

1. System shall have ability to dial out in the event of an alarm.

I. Maintenance Management: System shall monitor equipment status and generate maintenance messages based on operator-designated run-time, starts, and calendar date limits.

J. Sequencing: Include application software based on sequences of operation indicated to properly sequence chillers, boilers, and other applicable HVAC equipment.

K. Control Loops:

1. Support any of the following control loops, as applicable to control required:

   a. Two-position (on/off, open/close, slow/fast) control.
   b. Proportional control.
   c. Proportional plus integral (PI) control.
   d. Proportional plus integral plus derivative (PID) control.

   1) Include PID algorithms with direct or reverse action and anti-windup.
   2) Algorithm shall calculate a time-varying analog value used to position an output or stage a series of outputs.
   3) Controlled variable, set point, and PID gains shall be operator-selectable.
   e. Adaptive (automatic tuning).

L. Staggered Start: Application shall prevent all controlled equipment from simultaneously restarting after a power outage. Order which equipment (or groups of equipment) is started, along with the time delay between starts, shall be operator-selectable.

M. Anti-Short Cycling:

1. BO points shall be protected from short cycling.
2. Feature shall allow minimum on-time and off-time to be selected.

N. On and Off Control with Differential:

1. Include an algorithm that allows a BO to be cycled based on a controlled variable and set point.
2. Algorithm shall be direct- or reverse-acting and incorporate an adjustable differential.

O. Run-Time Totalization:

1. Include software to totalize run-times for all BI points.
2. A high run-time alarm shall be assigned, if required, by operator.

2.11 ENCLOSURES

A. General Enclosure Requirements:
1. House each controller and associated control accessories in a single enclosure. Enclosure shall serve as central tie-in point for control devices such as switches, transmitters, transducers, power supplies and transformers.

2. Do not house more than one controller in a single enclosure.

3. Include enclosure door with key locking mechanism. Key locks alike for all enclosures and include one pair of keys per enclosure.

4. Equip doors of enclosures housing controllers and components with analog or digital displays with windows to allow visual observation of displays without opening enclosure door.

5. Individual wall-mounted single-door enclosures shall not exceed 36 inches wide and 48 inches high.

6. Include wall-mounted enclosures with brackets suitable for mounting enclosures to wall or freestanding support stand as indicated.

7. Supply each enclosure with a complete set of as-built schematics, tubing, and wiring diagrams and product literature located in a pocket on inside of door.

B. Internal Arrangement:

1. Internal layout of enclosure shall group and protect pneumatic, electric, and electronic components associated with a controller, but not an integral part of controller.

2. Arrange layout to group similar products together.

3. Include a barrier between line-voltage and low-voltage electrical and electronic products.

4. Factory or shop install products, tubing, cabling and wiring complying with requirements and standards indicated.

5. Terminate field cable and wire using heavy-duty terminal blocks.

6. Include spare terminals, equal to not less than 10 percent of used terminals.

7. Include spade lugs for stranded cable and wire.

8. Install a maximum of two wires on each side of a terminal.

9. Include enclosure field power supply with a toggle-type switch located at entrance inside enclosure to disconnect power.

10. Include enclosure with a line-voltage nominal 20-A GFCI duplex receptacle for service and testing tools. Wire receptacle on hot side of enclosure disconnect switch and include with a 5-A circuit breaker.

11. Mount products within enclosure on removable internal panel(s).

12. Include products mounted in enclosures with engraved, laminated phenolic nameplates (black letters on a white background). The nameplates shall have at least 1/4-inch-high lettering.

13. Route tubing cable and wire located inside enclosure within a raceway with a continuous removable cover.

14. Label each end of cable, wire and tubing in enclosure following an approved identification system that extends from field I/O connection and all intermediate connections throughout length to controller connection.

15. Size enclosure internal panel to include at least [25] <Insert number> percent spare area on face of panel.

C. Environmental Requirements:

1. Evaluate temperature and humidity requirements of each product to be installed within each enclosure.
2. Calculate enclosure internal operating temperature considering heat dissipation of all products installed within enclosure and ambient effects (solar, conduction and wind) on enclosure.

3. Where required by application, include temperature-controlled electrical heat to maintain inside of enclosure above minimum operating temperature of product with most stringent requirement.

4. Where required by application, include temperature-controlled ventilation fans with filtered louver(s) to maintain inside of enclosure below maximum operating temperature of product with most stringent requirement.

D. Wall-Mounted, NEMA 250, Type 1:

1. Enclosure shall be NRTL listed according to UL 50 or UL 50E.
2. Construct enclosure of steel, not less than:
   a. Enclosure size less than 24 in.: Minimum 0.053 in. thick.
   b. Enclosure size 24 in. and larger: Minimum 0.067 in. thick.
3. Finish enclosure inside and out with polyester powder coating that is electrostatically applied and then baked to bond to substrate.
   a. Exterior color shall be manufacturer's standard.
   b. Interior color shall be manufacturer's standard.
4. Hinged door full size of front face of enclosure and supported using:
   a. Enclosures sizes less than 36 in. tall: Multiple butt hinges.
   b. Enclosures sizes 36 in. tall and larger: Continuous piano hinges.
5. Removable internal panel with a white polyester powder coating that is electrostatically applied and then baked to bond to substrate.
   a. Size less than 24 in.: Solid or Perforated steel, 0.053 in. thick.
   b. Size 24 in. and larger: Solid aluminum, 0.10 in. or steel, 0.093 in. thick.
6. Internal panel mounting hardware, grounding hardware and sealing washers.
7. Grounding stud on enclosure body.
8. Thermoplastic pocket on inside of door for record Drawings and Product Data.

E. Wall Mounted NEMA 250, Types 4 and 12:

1. Enclosure shall be NRTL listed according to UL 508A.
2. Seam and joints are continuously welded and ground smooth.
3. Where recessed enclosures are indicated, include enclosures with face flange for flush mounting.
4. Externally formed body flange around perimeter of enclosure face for continuous perimeter seamless gasket door seal.
5. Single-door enclosure sizes up to 60 inches tall by 36 inches wide.
6. Double-door enclosure sizes up to 36 inches tall by 60 inches wide.
7. Construct enclosure of steel, not less than the following:
a. Size Less Than 24 Inches: Minimum 0.053 inch thick.
b. Size 24 Inches and Larger: 0.067 inch thick.

8. Finish enclosure with polyester powder coating that is electrostatically applied and then baked to bond to substrate.
   a. Exterior color shall be manufacturer's standard.
   b. Interior color shall be manufacturer's standard.

9. Corner-formed door, full size of enclosure face, supported using multiple concealed hinges with easily removable hinge pins.
   a. Sizes through 24 Inches Tall: Two hinges.
   b. Sizes between 24 Inches through 48 Inches Tall: Three hinges.
   c. Sizes Larger 48 Inches Tall: Four hinges.

10. Double-door enclosures with overlapping door design to include unobstructed full-width access.
    a. Single-door enclosures 48 inches and taller, and all double-door enclosures, with three-point (top, middle and bottom) latch system.

11. Removable internal panel with a white polyester powder coating that is electrostatically applied and then baked to bond to substrate.
    a. Size Less Than 24 Inches: Solid or perforated steel, 0.053 inch thick.
    b. Size 24 Inches and Larger: Solid aluminum, 0.10 inch or steel, 0.093 inch thick.

12. Internal panel mounting studs with hardware, grounding hardware, and sealing washers.
14. Thermoplastic pocket on inside of door for record Drawings and Product Data.

F. Accessories:

1. Ventilation Fans, Filtered Intake and Exhaust Grilles:
   a. Number and size of fans, filters and grilles as required by application.
   b. Compact cooling fans engineered for 50,000 hours of continuous operation without lubrication or service.
   c. Fans capable of being installed on any surface and in any position within enclosure for spot cooling or air circulation.
   d. Thermostatic control with adjustable set point from 32 to 140 deg F.
   e. Airflow Capacity at Zero Pressure:
      1) 4-Inch Fan: 100 cfm.
      2) 6-Inch Fan: 240 cfm.
      3) 10-Inch Fan: 560 cfm.
   f. Maximum operating temperature of 158 deg F.
   g. 4-inch fan thermally protected and provided with permanently lubricated ball-bearings.
h. 6- and 10-inch fans with ball-bearing construction and split capacitor motors thermally protected to avoid premature failure.
i. Dynamically balanced impellers molded from polycarbonate material.
j. Fan furnished with power cord and polarized plug for power connection.
k. Fan brackets, finger guards and mounting hardware provided with fans to complete installation.
l. Removable Intake and Exhaust Grilles: ABS plastic of size to match fan size and suitable for NEMA 250, Types 1 and 12 enclosures.
m. Filters for NEMA 250, Type 1 Enclosures: Washable foam or aluminum, of a size to match intake grille.
n. Filters for NEMA 250, Type 12 Enclosures: Disposable, of a size to match intake grille.

2. Bar handle with keyed cylinder lock set.

2.12 RELAYS

A. General-Purpose Relays:

1. Relays shall be heavy duty and rated for at least 10 A at 250-V ac and 60 Hz.
2. Relays shall be either double pole double throw (DPDT) or three-pole double throw, depending on the control application.
3. Use a plug-in-style relay with an eight-pin octal plug for DPDT relays and an 11-pin octal plug for three-pole double-throw relays.
4. Construct the contacts of either silver cadmium oxide or gold.
5. Enclose the relay in a clear transparent polycarbonate dust-tight cover.
6. Relays shall have LED indication and a manual reset and push-to-test button.
7. Performance:
   a. Mechanical Life: At least 10 million cycles.
   b. Electrical Life: At least 100,000 cycles at rated load.
   c. Pickup Time: 15 ms or less.
   d. Dropout Time: 10 ms or less.
   e. Pull-in Voltage: 85 percent of rated voltage.
   f. Dropout Voltage: 50 percent of nominal rated voltage.
   g. Power Consumption: 2 VA.
   h. Ambient Operating Temperatures: Minus 40 to 115 deg F.

8. Equip relays with coil transient suppression to limit transients to non-damaging levels.
9. Plug each relay into an industry-standard, 35-mm DIN rail socket. Plug all relays located in control panels into sockets that are mounted on a DIN rail.
10. Relay socket shall have screw terminals. Mold into the socket the coincident screw terminal numbers and associated octal pin numbers.

B. Multifunction Time-Delay Relays:

1. Relays shall be continuous duty and rated for at least 10 A at 240-V ac and 60 Hz.
2. Relays shall be DPDT relay with up to eight programmable functions to provide on/off delay, interval and recycle timing functions.
3. Use a plug-in-style relay with either an 8- or 11-pin octal plug.
4. Construct the contacts of either silver cadmium oxide or gold.
5. Enclose the relay in a dust-tight cover.
6. Include knob and dial scale for setting delay time.
7. Performance:
   a. Mechanical Life: At least 10 million cycles.
   b. Electrical Life: At least 100,000 cycles at rated load.
   c. Timing Ranges: Multiple ranges from 0.1 seconds to 100 minutes.
   d. Repeatability: Within 2 percent.
   e. Recycle Time: 45 ms.
   f. Minimum Pulse Width Control: 50 ms.
   g. Power Consumption: 5 VA or less at 120-V ac.
   h. Ambient Operating Temperatures: Minus 40 to 115 deg F.
8. Equip relays with coil transient suppression to limit transients to non-damaging levels.
9. Plug each relay into an industry-standard, 35-mm DIN rail socket. Plug all relays located in control panels into sockets that are mounted on a DIN rail.
10. Relay socket shall have screw terminals. Mold into the socket the coincident screw terminal numbers and associated octal pin numbers.

C. Latching Relays:
1. Relays shall be continuous duty and rated for at least 10 A at 250-V ac and 60 Hz.
2. Relays shall be either DPDT or three-pole double throw, depending on the control application.
3. Use a plug-in-style relay with a multibladed plug.
4. Construct the contacts of either silver cadmium oxide or gold.
5. Enclose the relay in a clear transparent polycarbonate dust-tight cover.
6. Performance:
   a. Mechanical Life: At least 10 million cycles.
   b. Electrical Life: At least 100,000 cycles at rated load.
   c. Pickup Time: 15 ms or less.
   d. Dropout Time: 10 ms or less.
   e. Pull-in Voltage: 85 percent of rated voltage.
   f. Dropout Voltage: 50 percent of nominal rated voltage.
   g. Power Consumption: 2 VA.
   h. Ambient Operating Temperatures: Minus 40 to 115 deg F.
7. Equip relays with coil transient suppression to limit transients to non-damaging levels.
8. Plug each relay into an industry-standard, 35-mm DIN rail socket. Plug all relays located in control panels into sockets that are mounted on a DIN rail.
9. Relay socket shall have screw terminals. Mold into the socket the coincident screw terminal numbers and associated octal pin numbers.

D. Current Sensing Relay:
1. Monitors ac current.
2. Independent adjustable controls for pickup and dropout current.
3. Energized when supply voltage is present and current is above pickup setting.
4. De-energizes when monitored current is below dropout current.
5. Dropout current is adjustable from 50 to 95 percent of pickup current.
6. Include a current transformer, if required for application.
7. House current sensing relay and current transformer in its own enclosure. Use NEMA 250, Type 12 enclosure for indoors and NEMA 250, Type 4 for outdoors.

E. Combination On-Off Status Sensor and On-Off Relay:

1. Description:
   a. On-off control and status indication in a single device.
   b. LED status indication of activated relay and current trigger.
   c. Closed-Open-Auto override switch located on the load side of the relay.

2. Performance:
   a. Ambient Temperature: Minus 30 to 140 deg F.

3. Status Indication:
   a. Current Sensor: Integral sensing for single-phase loads up to 20 A and external solid or split sensing ring for three-phase loads up to 150 A.
   b. Current Sensor Range: As required by application.
   c. Current Set Point: Fixed or adjustable as required by application.
   d. Current Sensor Output:
      1) Solid-state, single-pole double-throw contact rated for 30-V ac and dc and for 0.4 A.
      2) Solid-state, single-pole double-throw contact rated for 120-V ac and 1.0 A.
      3) Analog, zero- to 5- or 10-V dc.
      4) Analog, 4 to 20 mA, loop powered.

5. Enclosure: NEMA 250, Type 1 enclosure.

2.13 ELECTRICAL POWER DEVICES

A. Transformers:

1. Transformer shall be sized for the total connected load, plus an additional 25 percent of connected load.
2. Transformer shall be at least 40 VA.
3. Transformer shall have both primary and secondary fuses.

B. DC Power Supply:

1. Plug-in style suitable for mating with a standard eight-pin octal socket. Include the power supply with a mating mounting socket.
2. Enclose circuitry in a housing.
3. Include both line and load regulation to ensure a stable output. To protect both the power supply and the load, power supply shall have an automatic current limiting circuit.
4. Performance:
   a. Output voltage nominally 25-V dc within 5 percent.
   b. Output current up to 100 mA.
   c. Input voltage nominally 120-V ac, 60 Hz.
   d. Load regulation within 0.5 percent from zero- to 100-mA load.
   e. Line regulation within 0.5 percent at a 100-mA load for a 10 percent line change.
   f. Stability within 0.1 percent of rated volts for 24 hours after a 20-minute warmup.

2.14 PIPING AND TUBING

A. Pressure Instrument Signal Air, Tubing and Piping:
   1. Products in this paragraph are intended for use with the following:
      a. Signal air between pressure instruments, such as sensors, switches, transmitters, controllers, and accessories.

2. Copper Tubing:
   a. Seamless phosphor deoxidized copper, soft annealed or drawn tempered, with chemical and physical properties according to ASTM B75.
   b. Performance, dimensions, weight and tolerance according to ASTM B280.
   c. Diameter, as required by application, not less than nominal 0.25 inch.
   d. Wall thickness, as required by the application, but not less than 0.030 inch.

3. Copper Tubing Connectors and Fittings:
   a. Brass, compression type.
   b. Brass, solder-joint type.

4. Polyethylene Tubing:
   a. Fire-resistant black virgin polyethylene according to ASTM D1248, Type 1, Class C and Grade 5.
   b. Tubing shall comply with stress crack test according to ASTM D1693.
   c. Diameter, as required by application, of not less than nominal 0.25 inch.

5. Polyethylene Tubing Connectors and Fittings:
   a. Brass, fittings.
   b. Brass, compression type.

B. Process Tubing:
   1. Products in this paragraph are intended for signals to instruments connected to liquid systems.
2. Copper Tubing:
   a. Seamless phosphor deoxidized copper, soft annealed or drawn tempered with chemical and physical properties according to ASTM B75.
   b. Performance, dimensions, weight and tolerance according to ASTM B280.
   c. Diameter, as required by application, of not less than nominal 0.25 inch.
   d. Wall thickness, as required by application, but not less than 0.030 inch.

3. Copper Tubing Connectors and Fittings:
   a. Brass, compression type.
   b. Brass, solder-joint type.

2.15 CONTROL WIRE AND CABLE

A. Wire: Single conductor control wiring above 24 V.
   1. Wire size shall be at least No. 18 AWG.
   2. Conductor shall be 7/24 soft annealed copper strand with 2- to 2.5-inch lay.
   3. Conductor insulation shall be 600 V, Type THWN or Type THHN, and 90 deg C according to UL 83.
   4. Conductor colors shall be black (hot), white (neutral), and green (ground).
   5. Furnish wire on spools.

B. Single Twisted Shielded Instrumentation Cable above 24 V:
   1. Wire size shall be a minimum No. 18 AWG.
   2. Conductors shall be a twisted, 7/24 soft annealed copper strand with a 2- to 2.5-inch lay.
   3. Conductor insulation shall have a Type THHN/THWN or Type TFN rating.
   4. Shielding shall be 100 percent type, 0.35/0.5-mil aluminum/Mylar tape, helically applied with 25 percent overlap, and aluminum side in with tinned copper drain wire.
   5. Outer jacket insulation shall have a 600-V, 90-deg C rating and shall be Type TC cable.
   6. For twisted pair, conductor colors shall be black and white. For twisted triad, conductor colors shall be black, red and white.
   7. Furnish wire on spools.

C. Single Twisted Shielded Instrumentation Cable 24 V and Less:
   1. Wire size shall be a minimum No. 18 AWG.
   2. Conductors shall be a twisted, 7/24 soft annealed copper stranding with a 2- to 2.5-inch lay.
   3. Conductor insulation shall have a nominal 15-mil thickness, constructed from flame-retardant PVC.
   4. Shielding shall be 100 percent type, 1.35-mil aluminum/polymer tape, helically applied with 25 percent overlap, and aluminum side in with tinned copper drain wire.
   5. Outer jacket insulation shall have a 300-V, 105-deg C rating and shall be Type PLTC cable.
   6. For twisted pair, conductor colors shall be black and white. For twisted triad, conductor colors shall be black, red and white.
   7. Furnish wire on spools.
D. LAN and Communication Cable: Comply with DDC system manufacturer requirements for network being installed.
   1. Cable shall be balanced twisted pair.
   2. Comply with the following requirements and for balanced twisted pair cable described in Section 260523 "Control-Voltage Electrical Power Cables."
   3. Cable shall be plenum rated.
   4. Cable shall comply with NFPA 70.
   5. Cable shall have a unique color that is different from other cables used on Project.

2.16 CONTROL POWER WIRING AND RACEWAYS
A. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" electrical power conductors and cables.
B. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems" for electrical power raceways and boxes.

2.17 ACCESSORIES
A. Damper Blade Limit Switches:
   1. Sense positive open and/or closed position of the damper blades.
   2. NEMA 250, Type 13, oil-tight construction.
   3. Arrange for the mounting application.
   4. Additional waterproof enclosure when required by its environment.
   5. Arrange to prevent "over-center" operation.
B. Manual Valves:
   1. Needle Type:
      a. PTFE packing.
      b. Construct of brass for use with copper and polyethylene tubing and of stainless steel for use with stainless-steel tubing.
      c. Aluminum T-bar handle.
      d. Include tubing connections.
   2. Ball Type:
      b. Ball: Type 316 stainless steel.
      c. Stem: Type 316 stainless steel.
      d. Seats: Reinforced PTFE.
      e. Packing Ring: Reinforced PTFE.
      f. Lever: Stainless steel with a vinyl grip.
      g. 600 WOG.
      h. Threaded end connections.
2.18 IDENTIFICATION

A. Instrument Air Pipe and Tubing:
   1. Engraved tag shall bear the following information:
      a. Service (Example): "Instrument Air."
      b. Pressure Range (Example): 0 to 30 psig.
   2. Letter size shall be a minimum of 0.25 inch high.
   3. Tag shall consist of white lettering on blue background.
   4. Tag shall be engraved phenolic consisting of three layers of rigid laminate. Top and bottom layers are color-coded blue with contrasting white center exposed by engraving through outer layer.
   5. Include tag with a brass grommet, chain and S-hook.

B. Control Equipment, Instruments, and Control Devices:
   1. Engraved tag bearing unique identification.
      a. Include instruments with unique identification identified by equipment being controlled or monitored, followed by point identification.
   2. Letter size shall be as follows:
      a. DDC Controllers: Minimum of 0.5 inch high.
      b. Enclosures: Minimum of 0.5 inch high.
      c. Electrical Power Devices: Minimum of 0.25 inch high.
      d. Accessories: Minimum of 0.25 inch high.
      e. Instruments: Minimum of 0.25 inch high.
      f. Control Damper and Valve Actuators: Minimum of 0.25 inch high.
   3. Tag shall consist of white lettering on black background.
   4. Tag shall be engraved phenolic consisting of three layers of rigid laminate. Top and bottom layers are color-coded black with contrasting white center exposed by engraving through outer layer.
   5. Tag shall be fastened with drive pins.
   6. Instruments, control devices and actuators with Project-specific identification tags having unique identification numbers following requirements indicated and provided by original manufacturer do not require an additional tag.

C. Valve Tags:
   1. Brass tags and brass chains attached to valve.
   2. Tags shall be at least 5 inches (38 mm) in diameter.
   3. Include tag with unique valve identification indicating control influence such as flow, level, pressure, or temperature; followed by location of valve, and followed by three-digit sequential number. For example: TV-1.001.
   4. Valves with Project-specific identification tags having unique identification numbers following requirements indicated and provided by original manufacturer do not require an additional tag.
D. Raceway and Boxes:
   1. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
   2. Paint cover plates on junction boxes and conduit same color as the tape banding for conduits. After painting, label cover plate "HVAC Controls," using an engraved phenolic tag.
   3. For raceways housing pneumatic tubing, add a phenolic tag labeled "HVAC Instrument Air Tubing."
   4. For raceways housing air signal tubing, add a phenolic tag labeled "HVAC Air Signal Tubing."

E. Equipment Warning Labels:
   1. Acrylic label with pressure-sensitive adhesive back and peel-off protective jacket.
   2. Lettering size shall be at least 14-point type with white lettering on red background.
   3. Warning label shall read "CAUTION-Equipment operated under remote automatic control and may start or stop at any time without warning. Switch electric power disconnecting means to OFF position before servicing."
   4. Lettering shall be enclosed in a white line border. Edge of label shall extend at least 0.25 inch beyond white border.

2.19 SOURCE QUALITY CONTROL

A. Product(s) and material(s) will be considered defective if they do not pass tests and inspections.

B. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
   1. Verify compatibility with and suitability of substrates.

B. Examine roughing-in for products to verify actual locations of connections before installation.
   1. Examine roughing-in for instruments installed in piping to verify actual locations of connections before installation.
   2. Examine roughing-in for instruments installed in duct systems to verify actual locations of connections before installation.

C. Examine walls, floors, roofs, and ceilings for suitable conditions where product will be installed.
D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

F. Communication Interface to Other Building Systems:
   1. DDC system shall have a communication interface with systems having a communication interface.
   2. Systems to Be Connected:
      a. Lighting controls specified in Section 260926 "Lighting Control Panelboards."
      b. Lighting controls specified in Section 260943.16 "Addressable-Luminaire Lighting Controls."
      c. Lighting controls specified in Section 260943.23 "Relay-Based Lighting Controls."
      d. Fire-alarm system specified in Section 284621.11 "Addressable Fire-Alarm Systems."
      e. Fire-alarm system specified in Section 284621.13 "Conventional Fire-Alarm Systems."

3.2 CONTROL DEVICES FOR INSTALLATION BY INSTALLERS

A. Deliver selected control devices, specified in indicated HVAC instrumentation and control device Sections, to identified equipment and systems manufacturers for factory installation and to identified installers for field installation.

B. Deliver the following to duct fabricator and Installer for installation in ductwork. Include installation instructions to Installer and supervise installation for compliance with requirements.
   1. DDC control dampers, which are specified in Section 230923.12 "DDC Control Dampers."
   2. Airflow sensors and switches, which are specified in Section 230923.14 "Flow Instruments."

C. Deliver the following to plumbing and HVAC piping installers for installation in piping. Include installation instructions to Installer and supervise installation for compliance with requirements.
   1. DDC control valves, which are specified in Section 230923.11 "Control Valves."
   2. Pipe-mounted flow meters, which are specified in Section 230923.14 "Flow Instruments."
   3. Pipe-mounted sensors, switches and transmitters. Flow meters are specified in Section 230923.14 "Flow Instruments." Liquid temperature sensors, switches, and transmitters are specified in Section 230923.27 "Temperature Instruments."
   4. Pipe- and tank-mounted thermowells. Liquid thermowells are specified in Section 230923.27 "Temperature Instruments."
3.3 CONTROL DEVICES FOR EQUIPMENT MANUFACTURER FACTORY INSTALLATION

A. Deliver the following to air-handling unit manufacturer for factory installation. Include installation instructions to air-handling unit manufacturer.

1. Programmable application controller.
2. Unit-mounted pressure sensors, switches and transmitters, which are specified in Section 230923.23 "Pressure Instruments."
3. Unit-mounted temperature sensors, switches and transmitters. Air-temperature sensors, switches, and transmitters are specified in Section 230923.27 "Temperature Instruments."
4. Relays.

B. Deliver the following to terminal unit manufacturer for factory installation. Include installation instructions to terminal unit manufacturer.

1. Programmable application or application-specific controller.
2. Electric damper actuator. Dampers actuators are specified in Section 230923.12 "Control Dampers."
3. Unit-mounted flow and pressure sensors, transmitters and transducers. Flow sensors, transmitters, and transducers are specified in Section 230923.14 "Flow Instruments."
Pressure sensors, switches, and transmitters are specified in Section 230923.23 "Pressure Instruments."
4. Unit-mounted temperature sensors. Air-temperature sensors, switches, and transmitters are specified in Section 230923.27 "Temperature Instruments."
5. Relays.

3.4 GENERAL INSTALLATION REQUIREMENTS

A. Install products to satisfy more stringent of all requirements indicated.

B. Install products level, plumb, parallel, and perpendicular with building construction.

C. Support products, tubing, piping wiring and raceways.

D. If codes and referenced standards are more stringent than requirements indicated, comply with requirements in codes and referenced standards.

E. Fabricate openings and install sleeves in ceilings, floors, roof, and walls required by installation of products. Before proceeding with drilling, punching, and cutting, check for concealed work to avoid damage. Patch, flash, grout, seal, and refinish openings to match adjacent condition.

F. Firestop Penetrations Made in Fire-Rated Assemblies: Comply with requirements in Section 078413 "Penetration Firestopping."

G. Seal penetrations made in acoustically rated assemblies. Comply with requirements in Section 079200 "Joint Sealants."

H. Welding Requirements:

1. Restrict welding and burning to supports and bracing.
2. No equipment shall be cut or welded without approval. Welding or cutting will not be approved if there is risk of damage to adjacent Work.
3. Welding, where approved, shall be by inert-gas electric arc process and shall be performed by qualified welders according to applicable welding codes.
4. If requested on-site, show satisfactory evidence of welder certificates indicating ability to perform welding work intended.

I. Fastening Hardware:
   1. Stillson wrenches, pliers, and other tools that damage surfaces of rods, nuts, and other parts are prohibited for work of assembling and tightening fasteners.
   2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
   3. Lubricate threads of bolts, nuts and screws with graphite and oil before assembly.

J. If product locations are not indicated, install products in locations that are accessible and that will permit service and maintenance from floor, equipment platforms, or catwalks without removal of permanently installed furniture and equipment.

3.5 CONTROLLER INSTALLATION

A. Install controllers in enclosures to comply with indicated requirements.
B. Connect controllers to field power supply.
C. Install controller with latest version of applicable software and configure to execute requirements indicated.
D. Test and adjust controllers to verify operation of connected I/O to achieve performance indicated requirements while executing sequences of operation.
E. Installation of Programmable Application Controllers:
   1. Quantity and location of programmable application controllers shall be determined by DDC system manufacturer to satisfy requirements indicated.
   2. Install controllers in a protected location that is easily accessible by operators.
   3. Top of controller shall be within 72 inches of finished floor.
F. Application-Specific Controllers:
   1. Quantity and location of application-specific controllers shall be determined by DDC system manufacturer to satisfy requirements indicated.
   2. For controllers not mounted directly on equipment being controlled, install controllers in a protected location that is easily accessible by operators.

3.6 ENCLOSURES INSTALLATION

A. Install the following items in enclosures, to comply with indicated requirements:
1. Controllers.
2. Electrical power devices.
3. Relays.

B. Attach wall-mounted enclosures to wall using the following types of steel struts:

1. For NEMA 250, Type 1 Enclosures: Use galvanized-steel strut and hardware.
2. For NEMA 250, Type 4 Enclosures and Enclosures Located Outdoors: Use stainless-steel strut and hardware.
3. Install plastic caps on exposed cut edges of strut.

C. Align top of adjacent enclosures.

D. Install continuous and fully accessible wireways to connect conduit, wire, and cable to multiple adjacent enclosures. Wireway used for application shall have protection equal to NEMA 250 rating of connected enclosures.

3.7 ELECTRIC POWER CONNECTIONS

A. Connect electrical power to DDC system products requiring electrical power connections.

B. Design of electrical power to products not indicated with electric power is delegated to DDC system provider and installing trade. Work shall comply with NFPA 70 and other requirements indicated.

C. Comply with requirements in Section 262816 "Enclosed Switches and Circuit Breakers" for electrical power circuit breakers.

D. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for electrical power conductors and cables.

E. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems" for electrical power raceways and boxes.

3.8 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements in Section 260553 "Identification for Electrical Systems" for identification products and installation.

B. Install self-adhesive labels with unique identification on face for each of the following:

1. DDC controller.
2. Enclosure.
3. Electrical power device.
4. Accessory.

C. Install unique instrument identification on face of each instrument connected to a DDC controller.
D. Install unique identification on face of each control damper and valve actuator connected to a DDC controller.

E. Where product is installed above accessible tile ceiling, also install matching identification on face of ceiling grid located directly below.

F. Where product is installed above an inaccessible ceiling, also install identification on face of access door directly below.

G. Warning Labels and Signs:
   1. Shall be permanently attached to equipment that can be automatically started by DDC control system.
   2. Shall be located in highly visible location near power service entry points.

3.9 NETWORK INSTALLATION

A. Install balanced twisted pair cable when connecting between the following:
   1. Network controllers and programmable application controllers.
   2. Programmable application controllers.
   3. Programmable application controllers and application-specific controllers.

B. Install cable in continuous raceway.
   1. Where indicated on Drawings, cable trays may be used for copper cable in lieu of conduit.

3.10 NETWORK NAMING AND NUMBERING

A. Coordinate with Owner and provide unique naming and addressing for networks and devices.

B. ASHRAE 135 Networks:
   1. MAC Address:
      a. Every network device shall have an assigned and documented MAC address unique to its network.
      b. Ethernet Networks: Document MAC address assigned at its creation.
      c. ARCNET or MS/TP networks: Assign from 00 to 64.
   2. Network Numbering:
      a. Assign unique numbers to each new network.
      b. Provide ability for changing network number through device switches or operator interface.
      c. DDC system, with all possible connected LANs, can contain up to 65,534 unique networks.
3. Device Object Identifier Property Number:
   a. Assign unique device object identifier property numbers or device instances for each device network.
   b. Provide for future modification of device instance number by device switches or operator interface.
   c. LAN shall support up to 4,194,302 unique devices.

4. Device Object Name Property Text:
   a. Device object name property field shall support 32 minimum printable characters.
   b. Assign unique device "Object Name" property names with plain-English descriptive names for each device.
      1) Example 1: Device object name for device controlling boiler plant at Building 1000 would be "HW System B1000."
      2) Example 2: Device object name for a VAV terminal unit controller could be "VAV unit 102."

5. Object Name Property Text for Other Than Device Objects:
   a. Object name property field shall support 32 minimum printable characters.
   b. Assign object name properties with plain-English names descriptive of application.
      1) Example 1: "Zone 1 Temperature."
      2) Example 2 "Fan Start and Stop."

6. Object Identifier Property Number for Other Than Device Objects:
   a. Assign object identifier property numbers according to Drawings or tables indicated.
   b. If not indicated, object identifier property numbers may be assigned at Installer's discretion but must be approved by Owner in advance, be documented and be unique for like object types within device.

3.11 PIPING AND TUBING INSTALLATION

A. Above-Grade Air Signal Piping and Tubing Installation:

1. Material Application:
   a. Install copper tubing, except as follows:
      1) Tubing Exposed to View: Polyethylene tubing installed in raceways may be used in lieu of copper tubing.
      2) Concealed Tubing: Polyethylene tubing may be used in lieu of copper tubing when concealed behind accessible ceilings.
   b. Install copper tubing for air signals to instruments including, but not limited to, the following:
1) Sensors.
2) Switches.
3) Transmitters.

c. Install drawn-temper copper tubing, except within 36 inches of device terminations tubing shall be annealed-tempered copper tubing.
d. Install compression fittings to connect copper tubing to instruments, control devices, and accessories.
e. Install barbed or compression fittings to connect polyethylene tubing to instruments, control devices, and accessories.

2. Routing:
a. Do not expose tubing in finished spaces, such as spaces with ceilings; occupied spaces, offices, and conference rooms, unless expressly approved in writing by Architect. Tubing may be exposed in areas without ceilings.
b. Where tubing is installed in finished occupied spaces, install the tubing in surface metal raceway with appropriate fittings only where not feasible to conceal in wall, above ceiling or behind architectural enclosures or covers.
c. Install piping and tubing plumb and parallel to and at right angles with building construction.
d. Install multiple runs of tubing or piping in equally spaced parallel lines.
e. Piping and tubing shall not interfere with access to valves, equipment, duct and equipment access doors, or obstruct personnel access and passageways of any kind.
f. Coordinate with other trades before installation to prevent proposed piping and tubing from interfering with pipe, duct, terminal equipment, light fixtures, conduit and cable tray space. If changes to Shop Drawings are necessary due to field coordination, document changes on record Drawings.
g. Install vibration loops in copper tubing when connecting to instrument and actuators that vibrate.

3. Support:
a. According to MSS SP-69, Table 3, except support spacing shall not exceed 60 inches.
b. Support copper tubing with copper hangers, clips, and tube trays.
c. Do not use tape for support or dielectric isolation.
d. Install supports at each change in direction and at each branch take off.
e. Attached supports to building structure independent of work of other trades. Support from ducts, pipes, cable trays, and conduits is prohibited.
f. Attached support from building structure with threaded rods, structural shapes, or channel strut.
g. Install and brace supports to carry static load plus a safety margin, which will allow tubing to be serviced.
h. Brace supports to prevent lateral movement.
i. Paint steel support members that are not galvanized or zinc coated.
j. Support polyethylene tubing same as copper tubing.

4. Do not attach piping and tubing to equipment that may be removed frequently for maintenance or that may impart vibration and expansion from temperature change.
5. Protect exposed tubing in mechanical equipment rooms from mechanical damage within 76 inches above floor. Use aluminum channel reversed and secured over tubing to protect tubing from damage.

6. Joining and Makeup:
   a. Where joining and mating dissimilar metals where galvanic action could occur, install dielectric isolation.
   b. Install a dirt leg with an isolation valve and threaded plug at each main air, connection to a panel, pneumatic pilot positioner and PRV station.
   c. Make threaded joints for connecting to instrument equipment with connectors with a compression tubing connector on one end and threaded connection on other end.
   d. Make tubing bends with a tube-bending tool. Hard bends, wrinkled or flattened bends are unacceptable.
   e. Install tube fittings according to manufacturer's written instructions.
   f. Do not make tubing connections to a fitting before completing makeup of the connection.
   g. Align tubing with the fitting. Avoid springing tube into position, as this may result in excessive stress on both tubing and fitting with possible resulting leaks.
   h. Do not install fittings close to a bend. A length of straight tubing, not deformed by bending, is required for a proper connection.
   i. Check tubing for correct diameter and wall thickness.
   j. Tube ends shall be cut square and deburred. Exercise care during cutting to keep tubing round.
   k. Thread pipe on a threading machine. Ream inner edges of pipe ends, file and grind to remove burrs.
   l. Wrap pipe threads of fittings on pneumatic lines with a single wrap of PTFE tape.
   m. Protect piping and tubing from entrance of foreign matter.

7. Conduit in which nonmetallic tubing is installed shall not exceed 50 percent fill. Support conduit according to NFPA 70 unless otherwise indicated.

B. Identify piping and tubing as follows:

   1. Every 50 feet of straight run.
   2. At least once for each branch within 36 inches of main tee.
   3. At each change in direction.
   4. Within 36 inches of each ceiling, floor, roof and wall penetration.
   5. Where exposed to and where concealed from view, including above ceiling plenums, shafts, and chases.
   6. At each valve.
   7. Mark each instrument tube connection with a number-coded identification. Each unique tube shall have same unique number at instrument connection and termination at opposite end of tube.

C. Isolation Valves Installation:

   1. Install valves full size of piping and tubing.
   2. Install at the following locations:
      a. At each branch.
      b. Before and after each PRV.
c. Before and after each air dryer.
d. At each control device.

3. Valves shall be located to be readily accessible from floor.

D. Process Tubing Installation:

1. Install process tubing for signal to instruments in liquid and steam systems. Instruments include, but are not limited to, the following:
   a. Meters.
   b. Sensors.
   c. Switches.
   d. Transmitters.

2. Support tubing according to MSS SP-69, Table 3, but at intervals no less than 60 inches.
3. Install NPS 1/2 process tubing for industrial-grade sensors, transmitters, and switches. Install stainless-steel bushings where required.
4. Make tubing bends with a bending tool. Flattened or wrinkled bends are unacceptable.
5. Support tubing independent of other trades.
6. Route tubing parallel to and at right angles to building construction.
7. Install tubing concealed in areas with ceilings.
8. Install a dirt leg with an isolation valve and threaded plug in drain valve at each connection to a transmitter and switch.
9. Insulate process piping connected to hot water and steam systems for personnel protection if the surface temperature exceeds 120 deg F. Only insulate piping within maintenance personnel reach from floor, platform, or catwalk.
10. Wrap pipe threads of fitting in process tubing with service temperatures below 350 deg F with a single wrap of PTFE tape.
11. Coat pipe threads of fittings on process tubing in services with temperatures exceeding 350 deg F with pipe compound before being made up to reduce the possibility of galling.
12. Do not make tubing connections to a fitting before completing makeup of the connection.
13. Check tubing for correct diameter and wall thickness. Cut the tube ends square and deburred. Exercise care during cutting to keep tubing round.
14. Do not install fittings close to a bend. A length of straight tubing, not deformed by bending, is required for a proper connection.
15. Align tubing with fitting when installed. Avoid springing tube into position.
16. Install tubing with extreme care exercised to keep foreign matter out of system. Open tubing ends shall be kept plugged to keep out dust, dirt and moisture.
17. Do not attach tubing to equipment that may be removed frequently for maintenance or may impart vibration and expansion from temperature change.
18. Protect exposed tubing in mechanical equipment rooms from inadvertent mechanical damage within 76 inches above floor. Use aluminum channel reversed and secured over tubing to protect tubing from damage.

E. Isolation Valves Installation:

1. Install valves full size of piping and tubing.
2. Install isolation valves at the following locations:
b. Inlet to each instrument including, sensors, transmitters, switches, gages, and other control devices.

3. Locate valves to be readily accessible from floor.

3.12 CONTROL WIRE, CABLE AND RACEWAYS INSTALLATION

A. Comply with NECA 1.

B. Wire and Cable Installation:

1. Comply with installation requirements in Section 260523 "Control-Voltage Electrical Power Cables."
2. Comply with installation requirements in Section 271313 "Communications Copper Backbone Cabling."
3. Comply with installation requirements in Section 271513 "Communications Copper Horizontal Cabling."
4. Install cables with protective sheathing that is waterproof and capable of withstanding continuous temperatures of 90 deg C with no measurable effect on physical and electrical properties of cable.
   a. Provide shielding to prevent interference and distortion from adjacent cables and equipment.
5. Provide strain relief.
6. Terminate wiring in a junction box.
   a. Clamp cable over jacket in junction box.
   b. Individual conductors in the stripped section of the cable shall be slack between the clamping point and terminal block.
7. Terminate field wiring and cable not directly connected to instruments and control devices having integral wiring terminals using terminal blocks.
8. Install signal transmission components according to IEEE C2, REA Form 511a, NFPA 70, and as indicated.
9. Use shielded cable to transmitters.
10. Use shielded cable to temperature sensors.
11. Perform continuity and meager testing on wire and cable after installation.

C. Conduit Installation:

1. Comply with Section "260533 "Raceways and Boxes for Electrical Systems" for control-voltage conductors.
2. Comply with Section 270528 "Pathways for Communications Systems" for balanced twisted pair cabling and optical fiber installation.

3.13 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and installations, including connections.

C. Perform the following tests and inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Testing of Air-Signal Tubing:
   a. Test for leaks and obstructions.
   b. Disconnect each pipe and tubing line before a test is performed, and blowout dust, dirt, trash, condensate and other foreign materials with compressed air. Use commercially pure compressed air or nitrogen as distributed in gas cylinders. Air from an oil-free compressor with an air dryer is an acceptable alternative for the test.
   c. After foreign matter is expelled and line is free from obstructions, plug far end of tubing run.
   d. Connect a pressure source to near end of run with a needle valve between air supply and tubing run.
   e. Connect a pressure gage accurate to within 0.5 percent of test between the shutoff needle valve and tubing run under test.
   f. For system pressures above 30 psig, apply a pressure of 1.5 times operating pressure. Record pressure in tubing run every 10 minutes for one hour. Allowable drop in pressure in one-hour period shall not exceed 1 psig.
   g. For system pressures 30 psig and below, apply a pressure of 2.0 times operating pressure to piping and tubing run. Record pressure in tubing run every 5 minutes for one hour. Allowable drop in pressure in one-hour period shall not exceed 0.5 psig.

D. Testing:

1. Perform preinstallation, in-progress, and final tests, supplemented by additional tests, as necessary.
2. Preinstallation Cable Verification: Verify integrity and serviceability for new cable lengths before installation. This assurance may be provided by using vendor verification documents, testing, or other methods. As a minimum, furnish evidence of verification for cable attenuation and bandwidth parameters.
3. In-Progress Testing: Perform standard tests for correct pair identification and termination during installation to ensure proper installation and cable placement. Perform tests in addition to those specified if there is any reason to question condition of material furnished and installed. Testing accomplished is to be documented by agency conducting tests. Submit test results for Project record.
4. Final Testing: Perform final test of installed system to demonstrate acceptability as installed. Testing shall be performed according to a test plan supplied by DDC system manufacturer. Defective Work or material shall be corrected and retested. As a minimum, final testing for cable system, including spare cable, shall verify conformance of attenuation, length, and bandwidth parameters with performance indicated.
5. Test Equipment: Use an optical fiber time domain reflectometer for testing of length and optical connectivity.
6. Test Results: Record test results and submit copy of test results for Project record.

3.14 DDC SYSTEM I/O CHECKOUT PROCEDURES

A. Check installed products before continuity tests, leak tests and calibration.

B. Check instruments for proper location and accessibility.

C. Check instruments for proper installation on direction of flow, elevation, orientation, insertion depth, or other applicable considerations that will impact performance.

D. Check instrument tubing for proper isolation, fittings, slope, dirt legs, drains, material and support.

E. Control Damper Checkout:
   1. Verify that control dampers are installed correctly for flow direction.
   2. Verify that proper blade alignment, either parallel or opposed, has been provided.
   3. Verify that damper frame attachment is properly secured and sealed.
   4. Verify that damper actuator and linkage attachment is secure.
   5. Verify that actuator wiring is complete, enclosed and connected to correct power source.
   6. Verify that damper blade travel is unobstructed.

F. Control Valve Checkout:
   1. For pneumatic valves, verify that pressure gages are provided in each air line to valve actuator and positioner.
   2. Verify that control valves are installed correctly for flow direction.
   3. Verify that valve body attachment is properly secured and sealed.
   4. Verify that valve actuator and linkage attachment is secure.
   5. Verify that actuator wiring is complete, enclosed and connected to correct power source.
   6. Verify that valve ball, disc or plug travel is unobstructed.
   7. After piping systems have been tested and put into service, but before insulating and balancing, inspect each valve for leaks. Adjust or replace packing to stop leaks. Replace the valve if leaks persist.

G. Instrument Checkout:
   1. Verify that instrument is correctly installed for location, orientation, direction and operating clearances.
   2. Verify that attachment is properly secured and sealed.
   3. Verify that conduit connections are properly secured and sealed.
   4. Verify that wiring is properly labeled with unique identification, correct type and size and is securely attached to proper terminals.
   5. Inspect instrument tag against approved submittal.
   6. For instruments with tubing connections, verify that tubing attachment is secure and isolation valves have been provided.
   7. For flow instruments, verify that recommended upstream and downstream distances have been maintained.
   8. For temperature instruments:
a. Verify sensing element type and proper material.
b. Verify length and insertion.

3.15 DDC SYSTEM I/O ADJUSTMENT, CALIBRATION AND TESTING:

A. Calibrate each instrument installed that is not factory calibrated and provided with calibration documentation.

B. Provide a written description of proposed field procedures and equipment for calibrating each type of instrument. Submit procedures before calibration and adjustment.

C. For each analog instrument, make a three-point test of calibration for both linearity and accuracy.

D. Equipment and procedures used for calibration shall comply with instrument manufacturer's written instructions.

E. Provide diagnostic and test equipment for calibration and adjustment.

F. Field instruments and equipment used to test and calibrate installed instruments shall have accuracy at least twice the instrument accuracy being calibrated. An installed instrument with an accuracy of 1 percent shall be checked by an instrument with an accuracy of 0.5 percent.

G. Calibrate each instrument according to instrument instruction manual supplied by manufacturer.

H. If after calibration indicated performance cannot be achieved, replace out-of-tolerance instruments.

I. Comply with field testing requirements and procedures indicated by ASHRAE's Guideline 11, "Field Testing of HVAC Control Components," in the absence of specific requirements, and to supplement requirements indicated.

J. Analog Signals:
   1. Check analog voltage signals using a precision voltage meter at zero, 50, and 100 percent.
   2. Check analog current signals using a precision current meter at zero, 50, and 100 percent.
   3. Check resistance signals for temperature sensors at zero, 50, and 100 percent of operating span using a precision-resistant source.

K. Digital Signals:
   1. Check digital signals using a jumper wire.
   2. Check digital signals using an ohmmeter to test for contact making or breaking.

L. Control Dampers:
   1. Stroke and adjust control dampers following manufacturer's recommended procedure, from 100 percent open to 100 percent closed and back to 100 percent open.
2. Stroke control dampers with pilot positioners. Adjust damper and positioner following manufacturer's recommended procedure, so damper is 100 percent closed, 50 percent closed and 100 percent open at proper air pressure.

3. Check and document open and close cycle times for applications with a cycle time less than 30 seconds.

4. For control dampers equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.

M. Control Valves:

1. Stroke and adjust control valves following manufacturer's recommended procedure, from 100 percent open to 100 percent closed and back to 100 percent open.

2. Stroke control valves with pilot positioners. Adjust valve and positioner following manufacturer's recommended procedure, so valve is 100 percent closed, 50 percent closed and 100 percent open at proper air pressures.

3. Check and document open and close cycle times for applications with a cycle time less than 30 seconds.

4. For control valves equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.

N. Sensors: Check sensors at zero, 50, and 100 percent of Project design values.

O. Switches: Calibrate switches to make or break contact at set points indicated.

P. Transmitters:

1. Check and calibrate transmitters at zero, 50, and 100 percent of Project design values.

2. Calibrate resistance temperature transmitters at zero, 50, and 100 percent of span using a precision-resistant source.

3.16 DDC SYSTEM CONTROLLER CHECKOUT

A. Verify power supply.

1. Verify voltage, phase and hertz.

2. Verify that protection from power surges is installed and functioning.

3. Verify that ground fault protection is installed.

4. If applicable, verify if connected to UPS unit.

5. If applicable, verify if connected to a backup power source.

6. If applicable, verify that power conditioning units, transient voltage suppression and high-frequency noise filter units are installed.

B. Verify that wire and cabling is properly secured to terminals and labeled with unique identification.

C. Verify that spare I/O capacity is provided.
3.17 DDC CONTROLLER I/O CONTROL LOOP TESTS

A. Testing:

1. Test every I/O point connected to DDC controller to verify that safety and operating control set points are as indicated and as required to operate controlled system safely and at optimum performance.
2. Test every I/O point throughout its full operating range.
3. Test every control loop to verify operation is stable and accurate.
4. Adjust control loop proportional, integral and derivative settings to achieve optimum performance while complying with performance requirements indicated. Document testing of each control loop's precision and stability via trend logs.
5. Test and adjust every control loop for proper operation according to sequence of operation.
6. Test software and hardware interlocks for proper operation. Correct deficiencies.
7. Operate each analog point at the following:
   a. Upper quarter of range.
   b. Lower quarter of range.
   c. At midpoint of range.
8. Exercise each binary point.
9. For every I/O point in DDC system, read and record each value at operator workstation, at DDC controller and at field instrument simultaneously. Value displayed at operator workstation, at DDC controller and at field instrument shall match.
10. Prepare and submit a report documenting results for each I/O point in DDC system and include in each I/O point a description of corrective measures and adjustments made to achieve desire results.

3.18 DDC SYSTEM VALIDATION TESTS

A. Perform validation tests before requesting final review of system. Before beginning testing, first submit Pretest Checklist and Test Plan.

B. After approval of Test Plan, execute all tests and procedures indicated in plan.

C. After testing is complete, submit completed test checklist.

D. Pretest Checklist: Submit the following list with items checked off once verified:

1. Detailed explanation for any items that are not completed or verified.
2. Required mechanical installation work is successfully completed and HVAC equipment is working correctly.
3. HVAC equipment motors operate below full-load amperage ratings.
4. Required DDC system components, wiring, and accessories are installed.
5. Control electric power circuits operate at proper voltage and are free from faults.
6. Required surge protection is installed.
7. DDC system network communications function properly, including uploading and downloading programming changes.
8. Using BACnet protocol analyzer, verify that communications are error free.
9. Each controller's programming is backed up.
10. Equipment, products, tubing, wiring cable and conduits are properly labeled.
11. All I/O points are programmed into controllers.
12. Testing, adjusting and balancing work affecting controls is complete.
13. Dampers and actuators zero and span adjustments are set properly.
14. Each control damper and actuator goes to failed position on loss of power.
15. Valves and actuators zero and span adjustments are set properly.
16. Each control valve and actuator goes to failed position on loss of power.
17. Meter, sensor and transmitter readings are accurate and calibrated.
18. Control loops are tuned for smooth and stable operation.
19. View trend data where applicable.
20. Each controller works properly in standalone mode.
21. Safety controls and devices function properly.
22. Interfaces with fire-alarm system function properly.
23. Electrical interlocks function properly.
24. Record Drawings are completed.

E. Test Plan:

1. Prepare and submit a validation test plan including test procedures for performance validation tests.
2. Test plan shall address all specified functions of DDC system and sequences of operation.
3. Explain detailed actions and expected results to demonstrate compliance with requirements indicated.
4. Explain method for simulating necessary conditions of operation used to demonstrate performance.
5. Include a test checklist to be used to check and initial that each test has been successfully completed.
6. Submit test plan documentation 10 business days before start of tests.

F. Validation Test:

1. Verify operating performance of each I/O point in DDC system.
   a. Verify analog I/O points at operating value.
   b. Make adjustments to out-of-tolerance I/O points.
      1) Identify I/O points for future reference.
      2) Simulate abnormal conditions to demonstrate proper function of safety devices.
      3) Replace instruments and controllers that cannot maintain performance indicated after adjustments.
2. Simulate conditions to demonstrate proper sequence of control.
3. Readjust settings to design values and observe ability of DDC system to establish desired conditions.
4. After 24 Hours following Initial Validation Test:
   a. Re-check I/O points that required corrections during initial test.
   b. Identify I/O points that still require additional correction and make corrections necessary to achieve desired results.
5. After 24 Hours of Second Validation Test:
   a. Re-check I/O points that required corrections during second test.
   b. Continue validation testing until I/O point is normal on two consecutive tests.

6. Completely check out, calibrate, and test all connected hardware and software to ensure that DDC system performs according to requirements indicated.

7. After validation testing is complete, prepare and submit a report indicating all I/O points that required correction and how many validation re-tests it took to pass. Identify adjustments made for each test and indicate instruments that were replaced.

3.19 FINAL REVIEW

A. Submit written request to Owner when DDC system is ready for final review. Written request shall state the following:

1. DDC system has been thoroughly inspected for compliance with contract documents and found to be in full compliance.
2. DDC system has been calibrated, adjusted and tested and found to comply with requirements of operational stability, accuracy, speed and other performance requirements indicated.
3. DDC system monitoring and control of HVAC systems results in operation according to sequences of operation indicated.
4. DDC system is complete and ready for final review.

B. Review by Owner shall be made after receipt of written request. A field report shall be issued to document observations and deficiencies.

C. Take prompt action to remedy deficiencies indicated in field report and submit a second written request when all deficiencies have been corrected. Repeat process until no deficiencies are reported.

D. Should more than two reviews be required, DDC system manufacturer and Installer shall compensate entity performing review for total costs, labor and expenses, associated with third and subsequent reviews. Estimated cost of each review shall be submitted and approved by DDC system manufacturer and Installer before making the review.

E. Prepare and submit closeout submittals when no deficiencies are reported.

F. A part of DDC system final review shall include a demonstration to parties participating in final review.

1. Provide staff familiar with DDC system installed to demonstrate operation of DDC system during final review.
2. Provide testing equipment to demonstrate accuracy and other performance requirements of DDC system that is requested by reviewers during final review.
3. Demonstration shall include, but not be limited to, the following:
   a. Accuracy and calibration of 10 I/O points randomly selected by reviewers. If review finds that some I/O points are not properly calibrated and not satisfying
performance requirements indicated, additional I/O points may be selected by reviewers until total I/O points being reviewed that satisfy requirements equals quantity indicated.

b. HVAC equipment and system hardwired and software safeties and life-safety functions are operating according to sequence of operation. Up to 10 I/O points shall be randomly selected by reviewers. Additional I/O points may be selected by reviewers to discover problems with operation.

c. Correct sequence of operation after electrical power interruption and resumption after electrical power is restored for randomly selected HVAC systems.

d. Operation of randomly selected dampers and valves in normal-on, normal-off and failed positions.

e. Reporting of alarm conditions for randomly selected alarms, including different classes of alarms, to ensure that alarms are properly received by operators and operator workstations.

f. Trends, summaries, logs and reports set-up for Project.

g. For both HVAC systems modified under this project, use graph trends to show that sequence of operation is executed in correct manner and that HVAC systems operate properly through complete sequence of operation including different modes of operations indicated. Show that control loops are stable and operating at set points and respond to changes in set point of 20 percent or more.

h. Software's ability to communicate with controllers, operator workstations, uploading and downloading of control programs.

i. Software's ability to edit control programs off-line.

j. Data entry to show Project-specific customizing capability including parameter changes.

k. Step through penetration tree, display all graphics, demonstrate dynamic update, and direct access to graphics.

l. Execution of digital and analog commands in graphic mode.

m. Spreadsheet and curve plot software and its integration with database.

n. Online user guide and help functions.

o. Multitasking by showing different operations occurring simultaneously on four quadrants of split screen.

p. For Each Programmable Application Controller:

1) Memory: Programmed data, parameters, trend and alarm history collected during normal operation is not lost during power failure.

2) Operator Interface: Ability to connect directly to each type of digital controller with a portable operator workstation and mobile device. Show that maintenance personnel interface tools perform as indicated in manufacturer's technical literature.

3) Standalone Ability: Demonstrate that controllers provide stable and reliable standalone operation using default values or other method for values normally read over network.

4) Electric Power: Ability to disconnect any controller safely from its power source.

5) Wiring Labels: Match control drawings.

6) Network Communication: Ability to locate a controller's location on network and communication architecture matches Shop Drawings.

7) Nameplates and Tags: Accurate and permanently attached to control panel doors, instrument, actuators and devices.
Communications and Interoperability: Demonstrate proper interoperability of data sharing, alarm and event management, trending, scheduling, and device and network management. Use ASHRAE 135 protocol analyzer to help identify devices, view network traffic, and verify interoperability. Requirements must be met even if only one manufacturer’s equipment is installed.

1) Data Presentation: On each operator workstation, demonstrate graphic display capabilities.
2) Reading of Any Property: Demonstrate ability to read and display any used readable object property of any device on network.
3) Set Point and Parameter Modifications: Show ability to modify set points and tuning parameters indicated. Modifications are made with messages and write services initiated by an operator using workstation graphics, or by completing a field in a menu with instructional text.
4) Peer-to-Peer Data Exchange: Network devices are installed and configured to perform without need for operator intervention to implement Project sequence of operation and to share global data.
5) Alarm and Event Management: Alarms and events are installed and prioritized according to Owner. Demonstrate that time delays and other logic are set up to avoid nuisance tripping. Show that operators with sufficient privileges are permitted.
6) Schedule Lists: Schedules are configured for start and stop, mode change, occupant overrides, and night setback as defined in sequence of operations.
7) Schedule Display and Modification: Ability to display any schedule with start and stop times for calendar year. Show that all calendar entries and schedules are modifiable from any connected operator workstation by an operator with sufficient privilege.
8) Archival Storage of Data: Data archiving is handled by operator workstation and server and local trend archiving and display is accomplished.
9) Modification of Trend Log Object Parameters: Operator with sufficient privilege can change logged data points, sampling rate, and trend duration.
10) Device and Network Management:
   a) Display of network device status.
   b) Display of BACnet Object Information.
   c) Silencing devices transmitting erroneous data.
   d) Time synchronization.
   e) Remote device re-initialization.
   f) Backup and restore network device programming and master database(s).
   g) Configuration management of routers.

3.20 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.
3.21 DEMONSTRATION

A. Engage a factory-authorized service representative with complete knowledge of Project-specific system installed to train Owner's maintenance personnel to adjust, operate, and maintain DDC system.

B. Extent of Training:

1. Base extent of training on scope and complexity of DDC system indicated and training requirements indicated. Provide extent of training required to satisfy requirements indicated even if more than minimum training requirements are indicated.
2. Inform Owner of anticipated training requirements if more than minimum training requirements are indicated.
3. Minimum Training Requirements:
   a. Provide not less than one day of training total.
   b. Total days of training shall be broken into not more than two separate training classes.

C. Training Schedule:

1. Schedule training with Owner 20 business days before expected Substantial Completion.
2. Schedule training to provide Owner with at least 10 business days of notice in advance of training.
3. Training shall occur within normal business hours at a mutually agreed on time. Unless otherwise agreed to, training shall occur Monday through Friday, except on U.S. Federal holidays, with two morning sessions and two afternoon sessions. Each morning session and afternoon session shall be split in half with 15-minute break between sessions. Morning and afternoon sessions shall be separated by 60-minute lunch period. Training, including breaks and excluding lunch period, shall not exceed eight hours per day.
4. Provide staggered training schedule as requested by Owner.

D. Training Attendee List and Sign-in Sheet:

1. Request from Owner in advance of training a proposed attendee list with name, phone number and e-mail address.
2. Provide a preprinted sign-in sheet for each training session with proposed attendees listed and no fewer than six blank spaces to add additional attendees.
3. Preprinted sign-in sheet shall include training session number, date and time, instructor name, phone number and e-mail address, and brief description of content to be covered during session. List attendees with columns for name, phone number, e-mail address and a column for attendee signature or initials.
4. Circulate sign-in sheet at beginning of each session and solicit attendees to sign or initial in applicable location.
5. At end of each training day, send Owner an e-mail with an attachment of scanned copy (PDF) of circulated sign-in sheet for each session.

E. Training Attendee Prior Knowledge: For guidance in planning required training and instruction, assume attendees have the following:

1. High school and technical school education and degree.
2. Intermediate user knowledge of computers and office applications.
3. Intermediate knowledge of HVAC systems.
4. Intermediate knowledge of DDC systems.
5. Intermediate knowledge of DDC system and products installed.

F. Attendee Training Manuals:
   1. Provide each attendee with a color hard copy of all training materials and visual presentations.
   2. Hard-copy materials shall be organized in a three-ring binder with table of contents and individual divider tabs marked for each logical grouping of subject matter. Organize material to provide space for attendees to take handwritten notes within training manuals.
   3. In addition to hard-copy materials included in training manual, provide each binder with a sleeve or pocket that includes a DVD or flash drive with PDF copy of all hard-copy materials.

G. Instructor Requirements:
   1. One or multiple qualified instructors, as required, to provide training.
   2. Instructors shall have not less than five years of providing instructional training on not less than five past projects with similar DDC system scope and complexity to DDC system installed.

H. Organization of Training Sessions:
   1. Organize training sessions into logical groupings of technical content and to reflect different levels of operators having access to system. Plan one training session to accommodate the following three levels of operators:
      a. Daily operators.
      b. Advanced operators.
      c. System managers and administrators.
   2. Plan and organize training sessions to group training content to protect DDC system security. Some attendees may be restricted to some training sessions that cover restricted content for purposes of maintaining DDC system security.

I. Training Outline:
   1. Submit training outline for Owner review at least 10 business day before scheduling training.
   2. Outline shall include a detailed agenda for each training day that is broken down into each of four training sessions that day, training objectives for each training session and synopses for each lesson planned.

J. On-Site Training:
   1. Owner will provide conditioned classroom or workspace with ample desks or tables, chairs, power and data connectivity for instructor and each attendee.
   2. Instructor shall provide training materials, projector and other audiovisual equipment used in training.
3. Provide as much of training located on-site as deemed feasible and practical by Owner.
4. On-site training shall include regular walk-through tours, as required, to observe each unique product type installed with hands-on review of operation, calibration and service requirements.
5. Operator workstation provided with DDC system shall be used in training. If operator workstation is not indicated, provide a temporary workstation to convey training content.

K. Training Content for Daily Operators:

1. Basic operation of system.
2. Understanding DDC system architecture and configuration.
3. Understanding each unique product type installed including performance and service requirements for each.
4. Understanding operation of each system and equipment controlled by DDC system including sequences of operation, each unique control algorithm and each unique optimization routine.
5. Operating operator workstations, printers and other peripherals.
6. Logging on and off system.
7. Accessing graphics, reports and alarms.
8. Adjusting and changing set points and time schedules.
9. Recognizing DDC system malfunctions.
10. Understanding content of operation and maintenance manuals including control drawings.
11. Understanding physical location and placement of DDC controllers and I/O hardware.
12. Accessing data from DDC controllers.
14. Review of DDC testing results to establish basic understanding of DDC system operating performance and HVAC system limitations as of Substantial Completion.
15. Running each specified report and log.
16. Displaying and demonstrating each data entry to show Project-specific customizing capability. Demonstrating parameter changes.
17. Stepping through graphics penetration tree, displaying all graphics, demonstrating dynamic updating, and direct access to graphics.
18. Executing digital and analog commands in graphic mode.
19. Demonstrating control loop precision and stability via trend logs of I/O for not less than 10 percent of I/O installed.
20. Demonstrating DDC system performance through trend logs and command tracing.
22. Demonstrating spreadsheet and curve plot software, and its integration with database.
23. Demonstrating on-line user guide, and help function and mail facility.
24. Demonstrating multitasking by showing dynamic curve plot, and graphic construction operating simultaneously via split screen.
25. Demonstrating the following for HVAC systems and equipment controlled by DDC system:

   a. Operation of HVAC equipment in normal-off, -on and failed conditions while observing individual equipment, dampers and valves for correct position under each condition.

   b. For HVAC equipment with factory-installed software, show that integration into DDC system is able to communicate with DDC controllers or gateways, as applicable.
c. Using graphed trends, show that sequence of operation is executed in correct manner, and HVAC systems operate properly through complete sequence of operation including seasonal change, occupied and unoccupied modes, warm-up and cool-down cycles and other modes of operation indicated.
d. Hardware interlocks and safeties function properly and DDC system performs correct sequence of operation after electrical power interruption and resumption after power is restored.
e. Reporting of alarm conditions for each alarm, and confirm that alarms are received at assigned locations, including operator workstations.
f. Each control loop responds to set point adjustment and stabilizes within time period indicated.
g. Sharing of previously graphed trends of all control loops to demonstrate that each control loop is stable and set points are being maintained.

L. Training Content for Advanced Operators:
1. Making and changing workstation graphics.
2. Creating, deleting and modifying alarms including annunciation and routing.
3. Creating, deleting and modifying point trend logs including graphing and printing on an ad-hoc basis and operator-defined time intervals.
4. Creating, deleting and modifying reports.
5. Creating, deleting and modifying points.
6. Creating, deleting and modifying programming including ability to edit control programs off-line.
7. Creating, deleting and modifying system graphics and other types of displays.
8. Adding DDC controllers and other network communication devices such as gateways and routers.
10. Performing DDC system checkout and diagnostic procedures.
11. Performing DDC controllers operation and maintenance procedures.
12. Performing operator workstation operation and maintenance procedures.
13. Configuring DDC system hardware including controllers, workstations, communication devices and I/O points.
14. Maintaining, calibrating, troubleshooting, diagnosing and repairing hardware.
15. Adjusting, calibrating and replacing DDC system components.

M. Training Content for System Managers and Administrators:
1. DDC system software maintenance and backups.
2. Uploading, downloading and off-line archiving of all DDC system software and databases.
3. Interface with Project-specific, third-party operator software.
4. Understanding password and security procedures.
5. Adding new operators and making modifications to existing operators.
6. Operator password assignments and modification.
7. Operator authority assignment and modification.
8. Workstation data segregation and modification.

END OF SECTION 230923
SECTION 230923.11 - CONTROL VALVES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes control valves and actuators for DDC systems.

B. Related Requirements:

1. Section 230923 "Direct-Digital Control System for HVAC" control equipment and software, relays, electrical power devices, uninterruptible power supply units, wire, and cable.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Include diagrams for power, signal, and control wiring.
2. Include diagrams for pneumatic signal and main air tubing.

C. Delegated-Design Submittal:

1. Schedule and design calculations for control valves and actuators, including the following:

   a. Flow at project design and minimum flow conditions.
   b. Pressure differential drop across valve at project design flow condition.
   c. Maximum system pressure differential drop (pump close-off pressure) across valve at project minimum flow condition.
   d. Design and minimum control valve coefficient with corresponding valve position.
   e. Maximum close-off pressure.
   f. Leakage flow at maximum system pressure differential.
   g. Torque required at worst case condition for sizing actuator.
   h. Actuator selection indicating torque provided.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.
PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASME Compliance: Fabricate and label products to comply with ASME Boiler and Pressure Vessel Code where required by authorities having jurisdiction.

C. Ground Fault: Products shall not fail due to ground fault condition when suitably grounded.

D. Determine control valve sizes and flow coefficients by ISA 75.01.01.

E. Control valve characteristics and rangeability shall comply with ISA 75.11.01.

F. Selection Criteria:

1. Control valves shall be suitable for operation at following conditions:
   a. Chilled Water: 200 psi at 70 deg. F.
   b. Heating Hot Water: 200 psi at 70 deg. F.

2. Fail positions unless otherwise indicated:
   b. Heating Hot Water: Last position.

3. Minimum Cv shall be calculated at 10 percent of design flow, with a coincident pressure differential equal to the system design pump head.

4. In water systems, select modulating control valves at terminal equipment for a design Cv based on a pressure drop of 5 psig at design flow unless otherwise indicated.

2.2 BALL-STYLE CONTROL VALVES

A. Ball Valves with Single Port and Characterized Disk:

1. Pressure Rating for NPS 1 and Smaller: Nominal 600 WOG.
2. Pressure Rating for NPS 1-1/2 through NPS 2: Nominal 400 WOG.
4. Process Temperature Range: Zero to 212 deg F.
7. Ball: Chrome-plated brass or bronze.
8. Stem and Stem Extension:
   a. Material to match ball.
   b. Blowout-proof design.
2.3 GLOBE-STYLE CONTROL VALVES

A. General Globe-Style Valve Requirements:
   1. Globe-style control valve body dimensions shall comply with ISA 75.08.01.
   2. Construct the valves to be serviceable from the top.
   3. For cage guided valves, trim shall be field interchangeable for different valve flow characteristics, such as equal percentage, linear, and quick opening.
   4. Reduced trim for one nominal size smaller shall be available for industrial valves NPS 1 and larger.
   5. Replaceable seats and plugs.
   6. Furnish each control valve with a corrosion-resistant nameplate indicating the following:
      a. Manufacturer's name, model number, and serial number.
      b. Body and trim size.
      c. Arrow indicating direction of flow.

B. Two-Way Globe Valves NPS 2 and Smaller:
   2. Body: Cast bronze or forged brass with ASME B16.5, Class 250 rating.
   8. Process Temperature Range: 35 to 248 deg F.
   9. Ambient Operating Temperature: 35 to 150 deg F.
   10. Leakage: FCI 70-2, Class IV.
   12. Equal percentage flow characteristic.

C. Two-Way Globe Valves NPS 2-1/2 to NPS 6:
   2. Body: Cast iron complying with ASME B61.1, Class 125.
   6. Plug: Top or bottom guided.
7. Plug, Seat, and Stem: Brass or stainless steel.
8. Process Temperature Rating: 35 to 281 deg F.
9. Leakage: 0.1 percent of maximum flow.
10. Rangeability: Varies with valve size between 6 and 10 to 1.
11. Modified linear flow characteristic.

2.4 ELECTRIC AND ELECTRONIC CONTROL VALVE ACTUATORS

A. Actuators for Hydronic Control Valves: Capable of closing valve against system pump shutoff head.

B. Position indicator and graduated scale on each actuator.

C. Type: Motor operated, with or without gears, electric and electronic.

D. Voltage: 24-V ac.

E. Deliver torque required for continuous uniform movement of controlled device from limit to limit when operated at rated voltage.

F. Function properly within a range of 85 to 120 percent of nameplate voltage.

G. Construction:

1. For Actuators Less Than 100 W: Fiber or reinforced nylon gears with steel shaft, copper alloy or nylon bearings, and pressed steel enclosures.
2. For Actuators from 100 to 400 W: Gears ground steel, oil immersed, shaft hardened steel running in bronze, copper alloy or ball bearings. Operator and gear trains shall be totally enclosed in dustproof cast-iron, cast-steel or cast-aluminum housing.
3. For Actuators Larger Than 400 W: Totally enclosed reversible induction motors with auxiliary hand crank and permanently lubricated bearings.

H. Field Adjustment:

1. Spring Return Actuators: Easily switchable from fail open to fail closed in the field without replacement.
2. Gear Type Actuators: External manual adjustment mechanism to allow manual positioning when the actuator is not powered.

I. Two-Position Actuators: Single direction, spring return or reversing type.

J. Modulating Actuators:

1. Operation: Capable of stopping at all points across full range, and starting in either direction from any point in range.
2. Control Input Signal:

a. Proportional: Actuator drives proportional to input signal and modulates throughout its angle of rotation. Suitable for zero- to 10- or 2- to 10-V dc and 4- to 20-mA signals.
b. Pulse Width Modulation (PWM): Actuator drives to a specified position according to pulse duration (length) of signal from a dry contact closure, triac sink, or source controller.

c. Programmable Multi-Function:

1) Control Input, Position Feedback, and Running Time: Factory or field programmable.
2) Diagnostic: Feedback of hunting or oscillation, mechanical overload, mechanical travel, and mechanical load limit.
3) Service Data: Include, at a minimum, number of hours powered and number of hours in motion.

K. Position Feedback:

1. Equip two-position actuators with limits switches or other positive means of a position indication signal for remote monitoring of open and close position.
2. Where indicated, equip modulating actuators with a position feedback through current or voltage signal for remote monitoring.
3. Provide a position indicator and graduated scale on each actuator indicating open and closed travel limits.

L. Fail-Safe:

1. Where indicated, provide actuator to fail to an end position.
2. Internal spring return mechanism to drive controlled device to an end position (open or close) on loss of power.
3. Batteries, capacitors, and other non-mechanical forms of fail-safe operation are acceptable only where uniquely indicated.

M. Integral Overload Protection:

1. Provide against overload throughout the entire operating range in both directions.
2. Electronic overload, digital rotation sensing circuitry, mechanical end switches, or magnetic clutches are acceptable methods of protection.

N. Valve Attachment:

1. Unless otherwise required for valve interface, provide an actuator designed to be directly coupled to valve shaft without the need for connecting linkages.
2. Attach actuator to valve drive shaft in a way that ensures maximum transfer of power and torque without slippage.
3. Bolt and set screw method of attachment is acceptable only if provided with at least two points of attachment.

O. Temperature and Humidity:

1. Temperature: Suitable for operating temperature range encountered by application with minimum operating temperature range of minus 20 to plus 120 deg F.
2. Humidity: Suitable for humidity range encountered by application; minimum operating range shall be from 5 to 95 percent relative humidity, non-condensing.
P. Enclosure:

1. Suitable for ambient conditions encountered by application.
2. NEMA 250, Type 2 for indoor and protected applications.
3. NEMA 250, Type 4 or Type 4X for outdoor and unprotected applications.
4. Provide actuator enclosure with heater and control where required by application.

Q. Stroke Time:

1. Operate valve from fully closed to fully open within 60 seconds.
2. Operate valve from fully open to fully closed within 60 seconds.
3. Move valve to failed position within 15 seconds.
4. Select operating speed to be compatible with equipment and system operation.

R. Sound:

1. Spring Return: 62 dBA.
2. Non-Spring Return: 45 dBA.

PART 3 - EXECUTION

3.1 CONTROL VALVE APPLICATIONS

A. Control Valves:

1. Select from valves specified in "Control Valves" Article to achieve performance requirements and characteristics indicated while subjected to full range of system operation encountered.
3. Heating Water Systems at terminal units, ball valves with single port and characterized disk.

3.2 INSTALLATION, GENERAL

A. Furnish and install products required to satisfy most stringent requirements indicated.

B. Install products level, plumb, parallel, and perpendicular with building construction.

C. Properly support instruments, tubing, piping, wiring, and conduits to comply with requirements indicated.

D. Provide ceiling, floor, roof, and wall openings and sleeves required by installation. Before proceeding with drilling, punching, or cutting, check location first for concealed products that could potentially be damaged. Patch, flash, grout, seal, and refinish openings to match adjacent condition.
E. Firestop penetrations made in fire-rated assemblies and seal penetrations made in acoustically rated assemblies.

F. Fastening Hardware:
   1. Stillson wrenches, pliers, and other tools that will cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for assembling and tightening nuts.
   2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
   3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.

G. Install products in locations that are accessible and that will permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.

3.3 ELECTRIC POWER
   A. Furnish and install electrical power to products requiring electrical connections.
   B. Furnish and install circuit breakers. Comply with requirements in Section 262816 "Enclosed Switches and Circuit Breakers."
   C. Furnish and install power wiring. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
   D. Furnish and install raceways. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems."

3.4 CONTROL VALVES
   A. Install pipe reducers for valves smaller than line size. Position reducers as close to valve as possible but at distance to avoid interference and impact to performance. Install with manufacturer-recommended clearance.
   B. Install flanges or unions to allow drop-in and -out valve installation.
   C. Where indicated, install control valve with three-valve bypass manifold to allow for control
   D. Install pressure temperature taps in piping upstream and downstream of each control valve larger than NPS 2.
   E. Valve Orientation:
      1. Where possible, install globe and ball valves installed in horizontal piping with stems upright and not more than 15 degrees off of vertical, not inverted.
      2. Install valves in a position to allow full stem movement.
      3. Where possible, install butterfly valves that are installed in horizontal piping with stems in horizontal position and with low point of disc opening with direction of flow.
F. Clearance:
1. Locate valves for easy access and provide separate support of valves that cannot be handled by service personnel without hoisting mechanism.
2. Install valves with at least 12 inches of clear space around valve and between valves and adjacent surfaces.

G. Threaded Valves:
1. Note internal length of threads in valve ends, and proximity of valve internal seat or wall, to determine how far pipe should be threaded into valve.
2. Align threads at point of assembly.
3. Apply thread compound to external pipe threads, except where dry seal threading is specified.
4. Assemble joint, wrench tight. Apply wrench on valve end as pipe is being threaded.

H. Flanged Valves:
1. Align flange surfaces parallel.
2. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.

I. Connect electrical devices and components to electrical grounding system. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

J. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

K. Install engraved phenolic nameplate with valve identification on valve actuator and on face of ceiling directly below valves concealed above ceilings.

3.5 CHECKOUT PROCEDURES

A. Control Valve Checkout:
1. Check installed products before continuity tests, leak tests, and calibration.
2. Check valves for proper location and accessibility.
3. Check valves for proper installation for direction of flow, elevation, orientation, insertion depth, or other applicable considerations that will impact performance.
4. For pneumatic products, verify air supply for each product is properly installed.
5. For pneumatic valves, verify that pressure gauges are provided in each air line to valve actuator and positioner.
6. Verify that control valves are installed correctly for flow direction.
7. Verify that valve body attachment is properly secured and sealed.
8. Verify that valve actuator and linkage attachment are secure.
9. Verify that actuator wiring is complete, enclosed, and connected to correct power source.
10. Verify that valve ball, disc, and plug travel are unobstructed.
11. After piping systems have been tested and put into service, but before insulating and balancing, inspect each valve for leaks. Adjust or replace packing to stop leaks. Replace the valve if leaks persist.

3.6 ADJUSTMENT, CALIBRATION, AND TESTING

A. Stroke and adjust control valves following manufacturer's recommended procedure, from 100 percent open to 100 percent closed back to 100 percent open.

B. Stroke control valves with pilot positioners. Adjust valve and positioner following manufacturer's recommended procedure, so valve is 100 percent closed, 50 percent closed, and 100 percent open at proper air pressures.

C. Check and document open and close cycle times for applications with a cycle time of less than 30 seconds.

D. For control valves equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.

END OF SECTION 230923.11
SECTION 230923.12 - CONTROL DAMPERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes control dampers and actuators for DDC systems.

B. Related Requirements:

1. Section 230923 "Direct-Digital Control System for HVAC" for control equipment and software, relays, electrical power devices, uninterruptible power supply units, wire, and cable.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASME Compliance: Fabricate and label products to comply with ASME Boiler and Pressure Vessel Code where required by authorities having jurisdiction.

C. Ground Fault: Products shall not fail due to ground fault condition when suitably grounded.

D. Selection Criteria:

1. Control dampers shall be suitable for operation at following conditions:

   a. Supply Air: 4.0 inches w.g. at 70 deg. F.
   b. Return Air: 4.0 inches w.g. at 70 deg. F.
   c. Outdoor Air: 4.0 inches w.g. at 70 deg. F.
   d. Mixed Air: 4.0 inches w.g. at 70 deg. F.
2. Fail positions unless otherwise indicated:
   a. Supply Air: Open.
   b. Return Air: Open.
   c. Outdoor Air: Close.
   d. Mixed Air: Last position.

3. Select modulating dampers for a pressure drop of 2 percent of fan total static pressure unless otherwise indicated.

2.2 RECTANGULAR CONTROL DAMPERS

A. General Requirements:
   1. Unless otherwise indicated, use parallel blade configuration for two-position control, equipment isolation service, and when mixing two airstreams. For other applications, use opposed blade configuration.
   2. Factory assemble multiple damper sections to provide a single damper assembly of size required by the application.

B. Rectangular Dampers with Aluminum Airfoil Blades:
   1. Performance:
      a. Leakage: AMCA 511, Class 1A. Leakage shall not exceed 3 cfm/sq. ft. against 1-in. wg differential static pressure.
      b. Pressure Drop: 0.05-in. wg at 1500 fpm across a 24-by-24-inch damper when tested according to AMCA 500-D, figure 5.3.
      c. Velocity: Up to 6000 fpm.
      d. Temperature: Minus 40 to plus 185 deg F.
      e. Pressure Rating: Damper close-off pressure equal to fan shutoff pressure with a maximum blade deflection of 1/200 of blade length.
      f. Damper shall have AMCA seal for both air leakage and air performance.

   2. Construction:
      a. Frame:
         1) Material: ASTM B211, Alloy 6063 T5 extruded-aluminum profiles, 0.07 inch thick.
         2) Hat-shaped channel with integral flange(s). Mating face shall be a minimum of 1 inch.
         3) Width not less than 5 inches.
      b. Blades:
         1) Hollow, airfoil, extruded aluminum.
         2) Parallel or opposed blade configuration as required by application.
         3) Material: ASTM B211, Alloy 6063 T5 aluminum, 0.07 inch thick.
         4) Width not to exceed 6 inches.
5) Length as required by close-off pressure, not to exceed 48 inches.

c. Seals:
   1) Blades: Replaceable, mechanically attached extruded silicone, vinyl, or plastic composite.
   2) Jambs: Stainless steel, compression type.

d. Axles: 0.5-inch-diameter plated steel, mechanically attached to blades.

e. Bearings:
   1) Molded synthetic or stainless-steel sleeve mounted in frame.
   2) Where blade axles are installed in vertical position, provide thrust bearings.

f. Linkage:
   1) Concealed in frame.
   2) Constructed of aluminum and plated steel.
   3) Hardware: Stainless steel.

2.3 GENERAL CONTROL-DAMPER ACTUATORS REQUIREMENTS

A. Actuators shall operate related damper(s) with sufficient reserve power to provide smooth modulating action or two-position action and proper speed of response at velocity and pressure conditions to which the damper is subjected.

B. Actuators shall produce sufficient power and torque to close off against the maximum system pressures encountered. Actuators shall be sized to close off against the fan shutoff pressure as a minimum requirement.

C. The total damper area operated by an actuator shall not exceed 80 percent of manufacturer's maximum area rating.

D. Provide one actuator for each damper assembly where possible. Multiple actuators required to drive a single damper assembly shall operate in unison.

E. Avoid the use of excessively oversized actuators which could overdrive and cause linkage failure when the damper blade has reached either its full open or closed position.

F. Use jackshafts and shaft couplings in lieu of blade-to-blade linkages when driving axially aligned damper sections.

G. Provide mounting hardware and linkages for connecting actuator to damper.

H. Select actuators to fail in desired position in the event of a power failure.

I. Actuator Fail Positions: [See Drawings.][As indicated below:]
   1. Outdoor Air: Close.
   2. Supply Air: Open.
3. Return Air: Open.

2.4 ELECTRIC AND ELECTRONIC ACTUATORS

A. Type: Motor operated, with or without gears, electric and electronic.

B. Voltage:

1. 24 V.
2. Actuator shall deliver torque required for continuous uniform movement of controlled device from limit to limit when operated at rated voltage.
3. Actuator shall function properly within a range of 85 to 120 percent of nameplate voltage.

C. Construction:

1. Less Than 100 W: Fiber or reinforced nylon gears with steel shaft, copper alloy or nylon bearings, and pressed steel enclosures.
2. 100 up to 400 W: Gears ground steel, oil immersed, shaft-hardened steel running in bronze, copper alloy, or ball bearings. Operator and gear trains shall be totally enclosed in dustproof cast-iron, cast-steel, or cast-aluminum housing.

D. Field Adjustment:

1. Spring return actuators shall be easily switchable from fail open to fail closed in the field without replacement.
2. Provide gear-type actuators with an external manual adjustment mechanism to allow manual positioning of the damper when the actuator is not powered.

E. Two-Position Actuators: Single direction, spring return or reversing type.

F. Modulating Actuators:

1. Capable of stopping at all points across full range, and starting in either direction from any point in range.
2. Control Input Signal:
   a. Proportional: Actuator drives proportional to input signal and modulates throughout its angle of rotation. Suitable for zero-to 10- or 2-to 10-V dc and 4-to 20-mA signals.
   b. Pulse Width Modulation (PWM): Actuator drives to a specified position according to a pulse duration (length) of signal from a dry-contact closure, triac sink or source controller.
   c. Programmable Multi-Function:
      1) Control input, position feedback, and running time shall be factory or field programmable.
2) Diagnostic feedback of hunting or oscillation, mechanical overload, mechanical travel, and mechanical load limit.
3) Service data, including at a minimum, number of hours powered and number of hours in motion.

G. Position Feedback:
   1. Equip two-position actuators with limits switches or other positive means of a position indication signal for remote monitoring of open and close position.
   2. Equip modulating actuators with a position feedback through current or voltage signal for remote monitoring.
   3. Provide a position indicator and graduated scale on each actuator indicating open and closed travel limits.

H. Fail-Safe:
   1. Where indicated, provide actuator to fail to an end position.
   2. Internal spring return mechanism to drive controlled device to an end position (open or close) on loss of power.
   3. Batteries, capacitors, and other non-mechanical forms of fail-safe operation are acceptable only where uniquely indicated.

I. Integral Overload Protection:
   1. Provide against overload throughout the entire operating range in both directions.
   2. Electronic overload, digital rotation sensing circuitry, mechanical end switches, or magnetic clutches are acceptable methods of protection.

J. Damper Attachment:
   1. Unless otherwise required for damper interface, provide actuator designed to be directly coupled to damper shaft without need for connecting linkages.
   2. Attach actuator to damper drive shaft in a way that ensures maximum transfer of power and torque without slippage.
   3. Bolt and set screw method of attachment is acceptable only if provided with at least two points of attachment.

K. Temperature and Humidity:
   1. Temperature: Suitable for operating temperature range encountered by application with minimum operating temperature range of minus 20 to plus 120 deg F.
   2. Humidity: Suitable for humidity range encountered by application; minimum operating range shall be from 5 to 95 percent relative humidity, non-condensing.

L. Enclosure:
   1. Suitable for ambient conditions encountered by application.
   2. NEMA 250, Type 2 for indoor and protected applications.
   3. NEMA 250, Type 4 or Type 4X for outdoor and unprotected applications.
   4. Provide actuator enclosure with a heater and controller where required by application.
M. Stroke Time:

1. Operate damper from fully closed to fully open within 60 seconds.
2. Operate damper from fully open to fully closed within 60 seconds.
3. Move damper to failed position within 15 seconds.
4. Select operating speed to be compatible with equipment and system operation.
5. Actuators operating in smoke control systems comply with governing code and NFPA requirements.

N. Sound:

1. Spring Return: 62 dBA.
2. Non-Spring Return: 45 dBA.

PART 3 - EXECUTION

3.1 CONTROL-DAMPER APPLICATIONS

A. Control Dampers:

B. Select from damper types indicated in "Control Dampers" Article to achieve performance requirements and characteristics indicated while subjected to full range of system operation encountered.

1. Rectangular Outdoor Air Duct Applications with SMACNA Construction Class 2.0 inches and Velocities to 2500 fpm: Rectangular dampers with aluminum airfoil blades.
2. Rectangular Return Air Duct Applications with SMACNA Construction Class 2.0 inches and Velocities to 2500 fpm: Rectangular dampers with aluminum airfoil blades.
3. Rectangular Supply Air Duct Applications with SMACNA Construction Class 4.0 inches and Velocities to 2500 fpm: Rectangular dampers with aluminum airfoil blades.

3.2 INSTALLATION, GENERAL

A. Furnish and install products required to satisfy most stringent requirements indicated.

B. Properly support dampers and actuators, tubing, wiring, and conduit to comply with requirements indicated.

C. Provide ceiling, floor, roof, and wall openings and sleeves required by installation. Before proceeding with drilling, punching, or cutting, check location first for concealed products that could potentially be damaged. Patch, flash, grout, seal, and refinish openings to match adjacent condition.

D. Seal penetrations made in fire-rated and acoustically rated assemblies.

E. Fastening Hardware:
1. Stillson wrenches, pliers, or other tools that will cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for assembling and tightening nuts.
2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.

F. Install products in locations that are accessible and that will permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.

3.3 ELECTRIC POWER

A. Furnish and install electrical power to products requiring electrical connections.

B. Furnish and install circuit breakers. Comply with requirements in Section 262816 "Enclosed Switches and Circuit Breakers."

C. Furnish and install power wiring. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

D. Furnish and install raceways. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems."

3.4 CONTROL DAMPERS

A. Install smooth transitions, not exceeding 30 degrees, to dampers smaller than adjacent duct. Install transitions as close to damper as possible but at distance to avoid interference and impact to performance. Consult manufacturer for recommended clearance.

B. Clearance:
   1. Locate dampers for easy access and provide separate support of dampers that cannot be handled by service personnel without hoisting mechanism.
   2. Install dampers with at least 24 inches of clear space on sides of dampers requiring service access.

C. Service Access:
   1. Dampers and actuators shall be accessible for visual inspection and service.
   2. Install access door(s) in duct or equipment located upstream of damper to allow service personnel to hand clean any portion of damper, linkage, and actuator. Comply with requirements in Section 233300 "Air Duct Accessories."

D. Install dampers straight and true, level in all planes, and square in all dimensions. Install supplementary structural steel reinforcement for large multiple-section dampers if factory support alone cannot handle loading.

E. Attach actuator(s) to damper drive shaft.
F. For duct-mounted and equipment-mounted dampers installed outside of equipment, install a visible and accessible indication of damper position from outside.

G. Connect electrical devices and components to electrical grounding system. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

H. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

I. Install engraved phenolic nameplate with damper identification on damper actuator.

3.5 CHECKOUT PROCEDURES

A. Control-Damper Checkout:

1. Check installed products before continuity tests, leak tests, and calibration.
2. Check dampers for proper location and accessibility.
3. Verify that control dampers are installed correctly for flow direction.
4. Verify that proper blade alignment, either parallel or opposed, has been provided.
5. Verify that damper frame attachment is properly secured and sealed.
6. Verify that damper actuator and linkage attachment are secure.
7. Verify that actuator wiring is complete, enclosed, and connected to correct power source.
8. Verify that damper blade travel is unobstructed.

3.6 ADJUSTMENT, CALIBRATION, AND TESTING:

A. Stroke and adjust control dampers following manufacturer's recommended procedure, from 100 percent open to 100 percent closed back to 100 percent open.

B. Check and document open and close cycle times for applications with a cycle time of less than 30 seconds.

C. For control dampers equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.

END OF SECTION 230923.12
SECTION 230923.21 - MOTION INSTRUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Dual-technology motion sensors for control of ventilation at AHU-5.

B. Related Requirements:

1. Section 230923 "Direct-Digital Control System for HVAC" for control equipment and software, relays, electrical power devices, uninterruptible power supply units, wire, and cable.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include operating characteristics; electrical characteristics; and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.

2. Include product description with complete technical data, performance curves, and product specification sheets.

B. Shop Drawings:

1. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

2. Include diagrams for power, signal, and control wiring.

3. Include number-coded identification system for unique identification of wiring, cable, and tubing ends.
1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plan drawings and corresponding product installation details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Product installation location shown in relationship to visual range and obstructions.
2. Ceiling-mounted instruments located in finished space showing relationship to other installed devices.

B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For motion instruments to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 INDOOR MOTION SENSORS

A. Description: Wall- or ceiling-mounted, solid-state units with a separate relay unit.

1. Operation: Unless otherwise indicated, turn on when covered area is occupied and off when unoccupied; with a time delay for turning off, adjustable over a minimum range of 1 to 15 minutes.
2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
3. Relay Unit: Dry contacts rated for 20-A load at 120- and 277-V ac. Power supply to sensor shall be 24-V dc, 150 mA, Class 2 power source as defined by NFPA 70.
4. Mounting:
   a. Sensor: Suitable for mounting in any position on a standard outlet box.
   b. Relay: Externally mounted through a 1/2-inch knock out in a standard electrical enclosure.
   c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
5. Indicator: Digital display, to show when motion is being detected during testing and normal operation of the sensor.
6. Bypass Switch: Override the on function in case of sensor failure.

B. Dual-Technology Type: Ceiling mounting; detect occupancy by using a combination of PIR and ultrasonic detection methods in coverage area. A particular technology or combination of technologies that controls on-off functions shall be field selectable by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6-inch-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.

3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling. Apply occupancy detectors where indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SENSOR INSTALLATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.

B. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.3 ELECTRICAL POWER

A. Furnish and install electrical power to products requiring electrical connections.

B. Furnish and install power wiring. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Furnish and install raceways. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems."

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate ventilation control devices and perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
   1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
   2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Motion instruments will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.6 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to one visits to Project during other-than-normal occupancy hours for this purpose.
   1. Verify operation at outer limits of detector range. Set time delay to suit Owner's operations.

3.7 DEMONSTRATION

A. Coordinate demonstration of products specified in this Section with demonstration requirements for direct-digital control systems specified in Section 230923 "Direct-Digital Control System for HVAC."

B. Train Owner's maintenance personnel to adjust, operate, and maintain ventilation control devices.

END OF SECTION 230923.21
SECTION 230923.22 - POSITION INSTRUMENTS

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes position limit switches for use in direct-digital control systems for HVAC.
B. Related Requirements:
   1. Section 230923 "Direct-Digital Control System for HVAC" for control equipment and software, relays, electrical power devices, uninterruptible power supply units, wire, and cable.

1.2 ACTION SUBMITTALS
A. Product Data: For each type of product.
B. Shop Drawings:
   1. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   2. Include diagrams for power, signal, and control wiring.
   3. Include number-coded identification system for unique identification of wiring.

PART 2 - PRODUCTS

2.1 POSITION LIMIT SWITCHES
A. Description: Select type of actuating head (plunger, roller lever, or rod) to suit application.
   1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
B. Performance:
   1. Life expectancy: Not less than 30 million mechanical operations and 750,000 electrical operations.
   2. Operating Frequency: 300 mechanical operations per minute and 30 electrical operations per minute.
   3. Voltage: 125-, 250-, 480-, and 600-V ac or 8-, 12-, 14-, 24-, 30-, 48-, 125-, and 250-V dc, as required by application.
   5. Temperature Rise: 50 deg C.
   6. Ambient Temperature: 14 to 175 deg F.
7. Ambient Relative Humidity: 35 to 95 percent.

C. Construction:

1. NEMA 250, Type 4X enclosure.
2. Switch Type: SPDT or DPDT, as required by application.
3. Status indicator integral to switch. Field switchable to light when contacts are actuated and operating, or contacts are free and not operating.
4. Electrical Connection: Screw or plug-in terminals.
5. Conduit Connection: NPS 1/2.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install products level, plumb, parallel, and perpendicular with building construction.

B. Properly support instruments, wiring, and conduit to comply with requirements indicated.

C. Fastening Hardware:

1. Stillson wrenches, pliers, and other tools that cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for work of assembling and tightening nuts.
2. Tighten bolts and nuts firmly and uniformly. Do not to overstress threads by using excessive force or oversized wrenches.
3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.

D. Install products in locations that are accessible and that permit maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.

3.2 ELECTRICAL POWER

A. Furnish and install electrical power to products requiring electrical connections.

B. Furnish and install circuit breakers. Comply with requirements in Section 262816 "Enclosed Switches and Circuit Breakers."

C. Furnish and install power wiring. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

D. Furnish and install raceways. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems."

3.3 POSITION INSTRUMENTS INSTALLATION

A. Mounting Location:
1. Rough-in instrument-mounting locations before setting instruments and routing, cable, wiring, and conduit to final location.

2. Use manufacturer mounting brackets to accommodate field mounting. Securely support and brace products to prevent vibration and movement.

B. Seal penetrations to ductwork, plenums, and air-moving equipment to comply with duct static-pressure class and leakage and seal classes indicated, using neoprene gaskets or grommets.

END OF SECTION 230923.22
SECTION 230923.23 - PRESSURE INSTRUMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Air-pressure sensors.
   2. Air-pressure switches.
   3. Air-pressure transmitters.
   4. Liquid-pressure transmitters.

B. Related Requirements:
   1. Section 230923 "Direct-Digital Control System for HVAC" for control equipment and software, relays, electrical power devices, uninterruptible power supply units, wire, and cable.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:
   1. Include plans, elevations, sections, and mounting details.
   2. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Number-coded identification system for unique identification of wiring, cable, and tubing ends.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.
PART 2 - PRODUCTS

2.1 AIR-PRESSURE SENSORS

A. Duct Insertion Static Pressure Sensor:
   1. Insertion length shall be at 8 inches.
   2. Sensor with four radial holes of 0.04-inch diameter.
   3. Brass or stainless-steel construction.
   4. Sensor with threaded end support, sealing washers and nuts.
   6. Suitable for flat oval, rectangular, and round duct configurations.

B. Outdoor Static Pressure Sensor:
   1. Sensor shall be enclosed in UV-resistant plastic housing with integral 1/2” EMT conduit fitting.
   2. Provides average outdoor pressure signal.
   3. Sensor with no moving parts.
   4. Kit includes sensor, vinyl tubing mounting hardware.
   5. Operating Range: Temperature -40 to 212 deg. F; Humidity 0% to 100%, RH, condensing.

C. Space Static Pressure Sensor for Recessed Ceiling Mounting:
   1. Aluminum round plate with perforated center arranged to sense space static pressure. Exposed surfaces provided with brush finish.
   2. Sensor intended for flush mount on face of ceiling with pressure chamber recessed in ceiling plenum.
   3. Back of sensor plate fitted with multiple sensing ports, pressure impulse suppression chamber, airflow shielding, and 0.125-inch fitting for concealed tubing connection.
   4. Performance: Within 1 percent of actual room static pressure in vicinity of sensor while being subjected to an air velocity of 1000 fpm from a 360 degree radial source.

2.2 AIR-PRESSURE SWITCHES

A. Air-Pressure Differential Switch:
   1. Diaphragm operated to actuate an SPDT snap switch.
   2. Electrical Connections: Three-screw configuration, including one screw for common operation and two screws for field-selectable normally open or closed operation.
   3. Enclosure Conduit Connection: Knock out or threaded connection.
   4. User Interface: Screw-type set-point adjustment located inside removable enclosure cover.
   6. Enclosure:
a. Dry Indoor Installations: NEMA 250, Type 1.

b. Outdoor and Wet Indoor Installations: NEMA 250, Type 4.

c. Hazardous Environments: Explosion proof.

7. Operating Data:

a. Electrical Rating: 15 A at 120- to 480-V ac.

b. Pressure Limits:

   1) Continuous: 45 inches wg.
   2) Surge: 10 psig.

c. Temperature Limits: Minus 30 to 180 deg F.

d. Operating Range: Approximately 2 times set point.

e. Repeatability: Within 3 percent.

f. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 AIR-PRESSURE TRANSMITTERS

A. Air-Pressure Differential Indicating Transmitter:

1. Performance:

a. Range: Approximately 2 times set point.

b. Accuracy Including Hysteresis and Repeatability: Within 1 percent of full scale at 77 deg F.

C. Stability: Within 1 percent of full scale per year.

D. Overpressure: 10 psig.

E. Temperature Limits: 20 to 120 deg F.

F. Thermal Effects: 0.055 percent of full scale per degree F.

2. Display: Four-digit digital display with minimum 0.4-inch-high numeric characters.

3. Operator Interface:

a. Zero and span adjustments.

b. Selectable engineering units.

4. Analog Output Current Signal:

a. Two-wire, 4- to 20-mA dc current source.

b. Signal capable of operating into a 1200-ohm load.

5. Construction:

a. Plastic casing with clear plastic cover.

b. Integral fittings for plastic tubing connections on side of instrument case for high- and low-pressure connections.

c. Terminal block for wire connections.

d. Vertical plane mounting.
e. NEMA 250, Type 1.
f. Nominal 4-inch diameter face.
g. Mounting Bracket: Appropriate for installation.

2.4 LIQUID-PRESSURE TRANSMITTERS

A. Liquid-Pressure Differential Transmitter:

1. Performance:
   a. Range: Approximately 2 times set point.
   b. Span: Adjustable plus or minus one milliamp, noninteractive.
   c. Accuracy: Within 0.25 percent of full scale.
   d. Pressure: Maximum operating pressure 2.5 times range.
   e. Temperature Limits: Zero to 175 deg F.
   f. Compensate Temperature Limits: 30 to 150 deg F.
   g. Thermal Effects: 0.02 percent of full scale per degree F.
   h. Response Time: 30 to 50 ms.
   i. Shock and vibration shall not harm the transmitter.

2. Analog Output Current Signal:
   a. Two-wire, 4- to 20-mA dc current source.
   b. Signal capable of operating into 1000-ohm load.

3. Operator Interface:
   a. Zero and span adjustments located behind cover.
   b. Bleed screws on side of body, two screws on low-pressure side, and one screw on high-pressure side, for air in line and pressure cavity.

4. Construction:
   a. Aluminum and stainless-steel enclosure with removable cover.
   b. Wetted parts of transmitter constructed of 17-4 PH or 300 Series stainless steel.
   c. Threaded, NPS 1/4 process connections on side of instrument enclosure.
   d. Knock out for 1/2-inch nominal conduit connection on side of instrument enclosure.
   e. Screw terminal block for wire connections.
   f. NEMA 250, Type 4X.
   g. Mounting Bracket: Appropriate for installation.

5. Three-valve manifold. Construct manifold of brass, bronze, or stainless steel. Manifold shall have threaded, NPS 1/4 process connections.
PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install products level, plumb, parallel, and perpendicular with building construction.

B. Properly support instruments, tubing, piping wiring, and conduit to comply with requirements indicated.

C. Provide ceiling, floor, roof, wall openings, and sleeves required by installation. Before proceeding with drilling, punching, or cutting, check location first for concealed products that could potentially be damaged. Patch, flash, grout, seal, and refinish openings to match adjacent condition.

D. Fastening Hardware:
   1. Stillson wrenches, pliers, and other tools that cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for work of assembling and tightening nuts.
   2. Tighten bolts and nuts firmly and uniformly. Do not to overstress threads by using excessive force or oversized wrenches.
   3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.

E. Install products in locations that are accessible and that permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.

3.2 ELECTRICAL POWER

A. Furnish and install electrical power to products requiring electrical connections.

B. Furnish and install circuit breakers. Comply with requirements in Section 262816 "Enclosed Switches and Circuit Breakers."

C. Furnish and install power wiring. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

D. Furnish and install raceways. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems."

3.3 PRESSURE INSTRUMENT INSTALLATION

A. Mounting Location:
   1. Rough-in: Outline instrument-mounting locations before setting instruments and routing, cable, wiring, tubing, and conduit to final location.
   2. Install switches and transmitters for air and liquid pressure associated with individual air-handling units and associated connected ductwork and piping near air-handlings units co-
located in air-handling unit system control panel, to provide service personnel a single and convenient location for inspection and service.

3. Install liquid pressure switches and transmitters for indoor applications in mechanical equipment rooms. Do not locate in user-occupied space unless indicated specifically on Drawings.

4. Install air-pressure switches and transmitters for indoor applications in mechanical equipment rooms. Do not locate in user-occupied space unless indicated specifically on Drawings.

5. Mount switches and transmitters not required to be mounted within system control panels on walls, floor-supported freestanding pipe stands, or floor-supported structural support frames. Use manufacturer mounting brackets to accommodate field mounting. Securely support and brace products to prevent vibration and movement.

6. Install instruments (except pressure gages) in liquid, and liquid-sealed piped services below their process connection point. Slope tubing down to instrument with a slope of 2 percent.

7. Install instruments in dry gas and noncondensable vapor piped services above their process connection point. Slope process connection lines up to instrument with a minimum slope of 2 percent.

B. Seal penetrations to ductwork, plenums, and air-moving equipment to comply with duct static pressure class and leakage and seal classes indicated using neoprene gaskets or grommets.

C. Duct Pressure Sensors:

1. Install sensors using manufacturer's recommended upstream and downstream distances.
2. Unless indicated on Drawings, locate sensors approximately 75 percent of distance of longest hydraulic run. Location of sensors shall be submitted and approved before installation.
3. Install mounting hardware and gaskets to make sensor installation airtight.
4. Route tubing from the sensor to transmitter.
5. Use compression fittings at terminations.
6. Install sensor in accordance with manufacturer's instructions.
7. Support sensor to withstand maximum air velocity, turbulence, and vibration encountered to prevent instrument failure.

D. Outdoor Pressure Sensors:

1. Locate wall-mounted sensor in an inconspicuous location.
2. Submit sensor location for approval before installation.
3. Verify signal from sensor is stable and consistent to all connected transmitters. Modify installation to achieve proper signal.
4. Route outdoor signal pipe full size of sensor connection to transmitters. Install branch connection of size required to match to transmitter.
5. Insulate signal pipe with flexible elastomeric insulation as required to prevent condensation.

E. Air-Pressure Differential Switches:

1. Install air-pressure sensor in system for each switch connection. Install sensor in an accessible location for inspection and replacement.
2. A single sensor may be used to share a common signal to multiple pressure instruments.
3. Install access door in duct and equipment to access sensors that cannot be inspected and replaced from outside.
4. Route NPS 3/8 tubing from sensor to switch connection.
5. Do not mount switches on rotating equipment.
6. Install switches in a location free from vibration, heat, moisture, or adverse effects, which could damage the switch and hinder accurate operation.
7. Install switches in an easily accessible location serviceable from floor.
8. Install switches adjacent to system control panel if within 50 feet; otherwise, locate switch in vicinity of system connection.

F. Liquid-Pressure Differential Switches:

1. Where process connections are located in mechanical equipment room, install switch in convenient and accessible location near system control panel.
2. Where process connections are installed outside mechanical rooms, route processing tubing to mechanical room housing system control panel and locate switch near system control panel.
3. Where multiple switches serving same system are installed in same room, install switches by system to provide service personnel a single and convenient location for inspection and service.
4. System process tubing connection shall be full size of switch connection, but not less than NPS 1/2. Install stainless-steel bushing if required to mate switch to system connection.
5. Connect process tubing from point of system connection and extend to switch.
6. Install isolation valves in process tubing as close to system connection as practical.
7. Install dirt leg and drain valve at each switch connection.
8. Do not mount switches on rotating equipment.
9. Install switches in a location free from vibration, heat, moisture, or adverse effects, which could damage the switch and hinder accurate operation.
10. Install switches in an easily accessible location serviceable from floor.

G. Liquid-Pressure Transmitters:

1. Where process connections are installed in mechanical equipment room, install transmitter in convenient and accessible location near system control panel.
2. Where process connections are installed outside mechanical rooms, route processing tubing to mechanical room housing system control panel and locate transmitter near system control panel.
3. Where multiple transmitters serving same system are installed in same room, install transmitters by system to provide service personnel a single and convenient location for inspection and service.
4. System process tubing connection shall be full size of switch connection, but not less than NPS 1/2. Install stainless-steel bushing if required to mate switch to system connection.
5. Connect process tubing from point of system connection and extend to transmitter.
6. Install isolation valves in process tubing as close to system connection as practical.
7. Install dirt leg and drain valve at each transmitter connection.
8. Do not mount transmitters on equipment.
9. Install in a location free from vibration, heat, moisture, or adverse effects, which could damage and hinder accurate operation.
3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Install engraved phenolic nameplate with instrument identification and on face of ceiling directly below instruments concealed above ceilings.

3.5 CHECKOUT PROCEDURES

A. Check out installed products before continuity tests, leak tests, and calibration.

B. Check instruments for proper location and accessibility.

C. Check instruments for proper installation with respect to direction of flow, elevation, orientation, insertion depth, or other applicable considerations that impact performance.

3.6 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain instrumentation and control devices.

END OF SECTION 230923.23
SECTION 230923.27 - TEMPERATURE INSTRUMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Air temperature sensors.
   2. Air temperature switches.
   3. Air temperature RTD transmitters.
   4. Liquid temperature sensors.

B. Related Requirements:
   1. Section 230923 "Direct-Digital Control System for HVAC" for control equipment and software, relays, electrical power devices, uninterruptible power supply units, wire, and cable.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:
   1. Include plans, elevations, sections, and mounting details.
   2. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Include diagrams for power, signal, and control wiring.
   4. Include number-coded identification system for unique identification of wiring, cable, and tubing ends.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Environmental Conditions:
1. Instruments shall operate without performance degradation under the ambient environmental temperature, pressure, humidity, and vibration conditions specified and encountered for installed location.

2. Instruments and accessories shall be protected with enclosures satisfying the following minimum requirements unless more stringent requirements are indicated. Instruments not available with integral enclosures complying with requirements indicated shall be housed in protective secondary enclosures. Instrument's installed location shall dictate following NEMA 250 enclosure requirements:
   a. Indoors, Heated with Filtered Ventilation: Type 1.
   b. Indoors, Heated with Non-Filtered Ventilation: Type 12.
   c. Indoors, Heated and Air Conditioned: Type 1.
   d. Mechanical Equipment Rooms:
      1) Air-Moving Equipment Rooms: Type 12.
   e. Within Duct Systems and Air-Moving Equipment Not Exposed to Possible Condensation: Type 12.
   f. Within Duct Systems and Air-Moving Equipment Exposed to Possible Condensation: Type 4.

2.2 AIR TEMPERATURE SENSORS

A. Platinum RTDs: Common Requirements:
   1. 1000 ohms at zero deg C and a temperature coefficient of 0.00385 ohm/ohm/deg C.
   2. Two-wire, PTFE-insulated, 22-gage stranded copper leads.
   3. Performance Characteristics:
      a. Range: Minus 50 to 275 deg F.
      b. Interchangeable Accuracy: At 32 deg F within 0.5 deg F.
      c. Repeatability: Within 0.5 deg F.
   4. Transmitter Requirements:
      a. Transmitter required for each 100-ohm RTD.
      b. Transmitter optional for 1000-ohm RTD, contingent on compliance with end-to-end control accuracy.

B. Platinum RTD, Single-Point Air Temperature Duct Sensors:
   1. 1000 ohms.
   2. Temperature Range: Minus 50 to 275 deg F
   4. Length: As required by application to achieve tip at midpoint of air tunnel, up to 18 inches.
   5. Enclosure: Junction box with removable cover; NEMA 250, Type 1 for indoor applications and Type 4 for outdoor applications.
6. Gasket for attachment to duct or equipment to seal penetration airtight.
7. Conduit Connection: 1/2-inch

C. Platinum RTD, Air Temperature Averaging Sensors:
   1. 1000 ohms.
   2. Temperature Range: Minus 50 to 275 deg F
   3. Multiple sensors to provide average temperature across entire length of sensor.
   4. Rigid probe of aluminum, brass, copper, or stainless-steel sheath.
   5. Flexible probe of aluminum, brass, copper, or stainless-steel sheath and formable to a 4-inch radius.
   6. Length: As required by application to cover entire cross section of air tunnel.
   7. Enclosure: Junction box with removable cover; NEMA 250, Type 1 for indoor applications and Type 4 for outdoor applications.
   8. Gasket for attachment to duct or equipment to seal penetration airtight.
   9. Conduit Connection: 1/2-inch

D. Platinum RTD Space Air Temperature Sensors:
   1. 1000 ohms.
   2. Temperature Range: Minus 50 to 212 deg F
   3. Sensor assembly shall include a temperature sensing element mounted under a bright white, non-yellowing, plastic cover.
   4. Provide a mounting plate that is compatible with the surface shape that it is mounted to and electrical box used.
   5. Concealed wiring connection.

E. Space Air Temperature Sensors for Use with DDC Controllers Controlling Terminal Units:
   1. 1000 ohm platinum RTD.
   2. Temperature Transmitter Requirements:
      a. Mating transmitters optional for 1000-ohm RTD and thermistor, contingent on compliance with end-to-end control accuracy.
   3. Provide digital display of sensed temperature.
   4. Provide sensor with local control.
      a. Local override to turn HVAC on.
      b. Both features shall be capable of manual override through control system operator.
   5. Where indicated on plans, provide combination temperature and carbon dioxide sensor and transmitter.
      a. Description:
         1) NDIR technology or equivalent technology providing long-term stability and reliability.
         2) Two-wire, 4-20 mA output signal, linearized to carbon-dioxide concentration in ppm.
b. Performance:

1) Measurement Range: Zero to 5000 ppm.
2) Accuracy: Within 2 percent of reading, plus or minus 30 ppm.
3) Repeatability: Within 1 percent of full scale.
4) Temperature Dependence: Within 0.05 percent of full scale over an operating range of 25 to 110 deg F.
5) Long-Term Stability: Within 5 percent of full scale after more than five years.
6) Response Time: Within 60 seconds.
7) Warm-up Time: Within five minutes.

c. Provide calibration kit. Turn over to Owner at start of warranty period.

2.3 AIR TEMPERATURE SWITCHES

A. Thermostat and Switch for Low Temperature Control in Duct Applications:

1. Description:

a. Two-position control.
b. Field-adjustable set point.
d. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Performance:

a. Operating Temperature Range: 15 to 55 deg F.
b. Temperature Differential: 5 deg F, non-adjustable and additive.
c. Enclosure Ambient Temperature: Minus 20 to 140 deg F.
d. Sensing Element Maximum Temperature: 250 deg F.
e. Voltage: 120-V ac.
f. Current: 16 FLA.
g. Switch Type: Two SPDT snap switches operate on coldest 12-inch section along element length.

3. Construction:

a. Vapor-Filled Sensing Element: Nominal 20 feet long.
b. Dual Temperature Scale: Fahrenheit and Celsius visible on face.
c. Set-Point Adjustment: Screw.
d. Enclosure: Painted metal, NEMA 250, Type 1.
e. Electrical Connections: Screw terminals.
f. Conduit Connection: 1/2-inch trade size.

B. Thermostat and Switch for High Temperature Control in Duct Applications:

1. Source Limitations: Obtain temperature-measuring sensors and transmitters and airflow from single manufacturer.
2. Description:
   a. Two-position control.
   b. Field-adjustable set point.
   d. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

3. Performance:
   a. Temperature Range: 100 to 160 deg F.
   b. Temperature Differential: 5 deg F.
   c. Ambient Temperature: Zero to 260 deg F.
   d. Voltage: 120-V ac.
   e. Current: 16 FLA.
   f. Switch Type: SPDT snap switch.

4. Construction:
   b. Enclosure: Metal, NEMA 250, Type 1.
   c. Electrical Connections: Screw terminals.
   d. Conduit Connection: 1/2-inch trade size.

2.4 AIR TEMPERATURE RTD TRANSMITTERS

A. Source Limitations: Obtain temperature-measuring sensors and transmitters and airflow from single manufacturer.

B. House electronics in NEMA 250 enclosure.
   1. Duct: Type 1.
   2. Space: Type 1.

C. Conduit Connection: 1/2-inch

D. Functional Characteristics:
   1. Input:
      a. 1000-ohm platinum RTD temperature coefficient of 0.00385 ohm/ohm/deg C, two-wire sensors.
   2. Span (Adjustable):
      a. Space: 40 to 90 deg F.
      b. Supply Air Cooling and Heating: 40 to 120 deg F.
      c. Supply Air Cooling Only: 40 to 90 deg F.
      d. Supply Air Heating Only: 40 to 120 deg F.
      e. Exhaust Air: 50 to 100 deg F.
f. Return Air: 50 to 100 deg F.
g. Mixed Air: Minus 40 to 140 deg F.
h. Outdoor: Minus 40 to 140 deg F.

3. Output: 4- to 20-mA dc, linear with temperature; RFI insensitive; minimum drive load of 600 ohms at 24-V dc.

4. Zero and span field adjustments, plus or minus 5 percent of span. Minimum span of 50 deg F.

5. Match sensor with temperature transmitter and factory calibrate together.

E. Performance Characteristics:

1. Calibration Accuracy: Within 0.1 percent of the span.
2. Stability: Within 0.2 percent of the span for at least 6 months.
3. Combined Accuracy: Within 0.5 percent.

2.5 LIQUID AND STEAM TEMPERATURE SENSORS, COMMERCIAL GRADE

A. RTD:

1. Description:

   a. Platinum with a value of 1000 ohms at zero deg C and a temperature coefficient of 0.00385 ohm/ohm/deg C.
   b. Encase RTD in a stainless-steel sheath with a 0.25-inch OD.
   c. Sensor Length: 4, 6, or 8 inches as required by application.
   d. Process Connection: Threaded, NPS 1/2
   e. Two-stranded copper lead wires.
   f. Powder-coated steel enclosure, NEMA 250, Type 4.
   g. Conduit Connection: 1/2-inch
   h. Performance Characteristics:

      1) Range: Minus 40 to 210 deg F.
      2) Interchangeable Accuracy: Within 0.54 deg F at 32 deg F.

B. Thermowells:

1. Stem: Straight or stepped shank formed from solid bar stock.
2. Material: Brass or stainless steel.
5. Bore: Sized to accommodate sensor with tight tolerance between sensor and well.
6. Furnish thermowells installed in insulated pipes and equipment with an extended neck.
7. Length: 4, 6, or 8 inches as required by application.
8. Thermowells furnished with heat-transfer compound to eliminate air gap between wall of sensor and thermowell and to reduce time constant.
2.6  LIQUID AND STEAM TEMPERATURE TRANSMITTERS, COMMERCIAL GRADE

A.  House electronics in NEMA 250, Type 4 enclosure.

B.  Enclosure Connection: 1/2-inch trade size.

C.  Functional Characteristics:

1.  Input: 100-ohm platinum RTD temperature coefficient of 0.00385 ohm/ohm/deg C, two- or three-wire sensors.
2.  Default Span (Adjustable):
   a.  Chilled Water: Zero to 100 deg F.
   b.  Heating Hot Water: 32 to 212 deg F.
3.  Output: 4- to 20-mA dc, linear with temperature; RFI insensitive; minimum drive load of 600 ohms at 24-V dc.
4.  Zero and span field adjustments, plus or minus 5 percent of span. Minimum span of 50 deg F.
5.  Match sensor with temperature transmitter and factory calibrate together. Each matched sensor and transmitter set shall include factory calibration data traceable to NIST.

D.  Performance Characteristics:

1.  Calibration Accuracy: Within 0.1 percent of the span.
2.  Stability: Within 0.2 percent of the span for at least 6 months.
3.  Combined Accuracy: Within 0.5 percent.

PART 3 - EXECUTION

3.1  TEMPERATURE INSTRUMENT APPLICATIONS

A.  Air Temperature Sensors:

1.  Duct: 1000-ohm platinum RTD.
2.  Outdoor: 1000-ohm platinum RTD.
3.  Space: 1000-ohm platinum RTD. Provide combination temperature and carbon dioxide sensor where indicated on drawings.

B.  Air Temperature Transmitters:

1.  Duct: Air temperature RTD transmitter.
2.  Outdoor: Air temperature RTD transmitter.

C.  Liquid and Steam Temperature Sensors:

D. Liquid and Temperature Transmitters:
   1. Chilled and Heating Water System,: Liquid and steam temperature transmitter, commercial grade.

3.2 INSTALLATION, GENERAL
A. Install products level, plumb, parallel, and perpendicular with building construction.
B. Properly support instruments, tubing, piping, wiring, and conduit to comply with requirements indicated.
C. Fastening Hardware:
   1. Stillson wrenches, pliers, and other tools that cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for work of assembling and tightening nuts.
   2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
   3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.
D. Install products in locations that are accessible and that permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.

3.3 ELECTRIC POWER
A. Furnish and install electrical power to products requiring electrical connections.
B. Furnish and install circuit breakers. Comply with requirements in Section 262816 "Enclosed Switches and Circuit Breakers."
C. Furnish and install power wiring. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
D. Furnish and install raceways. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems."

3.4 TEMPERATURE INSTRUMENT INSTALLATIONS
A. Mounting Location:
   1. Roughing In:
      a. Outline instrument mounting locations before setting instruments and routing cable, wiring, tubing, and conduit to final location.
      b. Provide independent inspection to confirm that proposed mounting locations comply with requirements indicated and approved submittals.
1) Indicate dimensioned locations with mounting height for all surface-
mounted products on Shop Drawings.
2) Do not begin installation without submittal approval of mounting location.

c. Complete installation rough-in only after confirmation by independent inspection
is complete and approval of location is documented for review by Owner and
Architect on request.

2. Install switches and transmitters for air and liquid temperature associated with individual
air-handling units and associated connected ductwork and piping near air-handling units
co-located in air-handling unit system control panel to provide service personnel a single
and convenient location for inspection and service.
3. Install liquid and steam temperature switches and transmitters for indoor applications in
mechanical equipment rooms. Do not locate in user-occupied space unless indicated
specifically on Drawings.
4. Install air temperature switches and transmitters for indoor applications in mechanical
equipment rooms. Do not locate in user-occupied space unless indicated specifically on
Drawings.
5. Mount switches and transmitters on walls, floor-supported freestanding pipe stands, or
floor-supported structural support frames. Use manufacturer's mounting brackets to
accommodate field mounting. Securely support and brace products to prevent vibration
and movement.

B. Special Mounting Requirements:

1. Protect products installed outdoors from solar radiation, building and wind effect with
stand-offs and shields constructed of Type 316 stainless.
2. Temperature instruments having performance impacted by temperature of mounting
substrate shall be isolated with an insulating barrier located between instrument and
substrate to eliminate effect. Where instruments requiring insulation are located in
finished space, conceal insulating barrier in a cover matching the instrument cover.

C. Mounting Height:

1. Mount temperature instruments in user-occupied space to match mounting height of light
switches unless otherwise indicated on Drawings. Mounting height shall comply with
codes and accessibility requirements.
2. Mount switches and transmitters located in mechanical equipment rooms and other
similar space not subject to code or state and Federal accessibility requirements within a
range of 42 to 72 inches above the adjacent floor, grade, or service catwalk or platform.

a. Make every effort to mount at 60 inches.

D. Seal penetrations to ductwork, plenums, and air-moving equipment to comply with duct static-
pressure class and leakage and seal classes indicated using neoprene gaskets or grommets.

E. Space Temperature Sensor Installation:

1. Conceal assembly in an electrical box of sufficient size to house sensor and transmitter, if
provided.
2. Install electrical box with a faceplate to match sensor cover if sensor cover does not completely cover electrical box.
3. In finished areas, recess electrical box within wall.
4. In unfinished areas, electrical box may be surface mounted if electrical light switches are surface mounted. Use a cast-aluminum electric box for surface-mounted installations.
5. Align electrical box with other electrical devices such as visual alarms and light switches located in the vicinity to provide a neat and well-thought-out arrangement. Where possible, align in both horizontal and vertical axis.

F. Outdoor Air Temperature Sensor Installation:
1. Mount sensor in a discrete location facing north.
2. Protect installed sensor from solar radiation and other influences that could impact performance.
3. If required to have a transmitter, mount transmitter remote from sensor in an accessible and serviceable location indoors.

G. Single-Point Duct Temperature Sensor Installation:
1. Install single-point-type, duct-mounted, supply- and return-air temperature sensors. Install sensors in ducts with sensitive portion of the element installed in center of duct cross section and located to sense near average temperature. Do not exceed 24 inches in sensor length.
2. Install return-air sensor in location that senses return-air temperature without influence from outdoor or mixed air.
3. Rigidly support sensor to duct and seal penetration airtight.
4. If required to have transmitter, mount transmitter remote from sensor at accessible and serviceable location.

H. Averaging Duct Temperature Sensor Installation:
1. Install averaging-type air temperature sensor for temperature sensors located within air-handling units, similar equipment, and large ducts with air tunnel cross-sectional area of 20 sq. ft. and larger.
2. Install sensor length to maintain coverage over entire cross-sectional area. Install multiple sensors where required to maintain the minimum coverage.
3. Fasten and support sensor with manufacturer-furnished clips to keep sensor taut throughout entire length.
4. If required to have transmitter, mount transmitter in an accessible and serviceable location.

I. Low-Limit Air Temperature Switch Installation:
1. Install multiple low-limit switches to maintain coverage over entire cross-sectional area of air tunnel.
2. Fasten and support sensing element with manufacturer-furnished clips to keep element taut throughout entire length.
3. Mount switches outside of airstream at a location and mounting height to provide easy access for switch set-point adjustment and manual reset.
4. Install on entering side of cooling coil unless otherwise indicated on Drawings.
J. Liquid Temperature Sensor Installation:

1. Assembly shall include sensor, thermowell and connection head.
2. For pipe NPS 4 and larger, install sensor and thermowell length to extend into pipe between 50 to 75 percent of pipe cross section.
3. For pipe smaller than NPS 4:
   a. Install reducers to increase pipe size to NPS 4 at point of thermowell installation.
   b. For pipe sizes NPS 2-1/2 and NPS 3, thermowell and sensor may be installed at pipe elbow or tee to achieve manufacturer-recommended immersion depth in lieu of increasing pipe size.
   c. Minimum insertion depth shall be 2-1/2 inches.
4. Install matching thermowell.
5. Fill thermowell with heat-transfer fluid before inserting sensor.
6. Tip of spring-loaded sensors shall contact inside of thermowell.
7. For insulated piping, install thermowells with extension neck to extend beyond face of insulation.
8. Install thermowell in top dead center of horizontal pipe positioned in an accessible location to allow for inspection and replacement. If top dead center location is not possible due to field constraints, install thermowell at location along top half of pipe.
9. For applications with transmitters, mount transmitter remote from sensor in an accessible and serviceable location from floor.

3.5 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Install engraved phenolic nameplate with instrument identification.

3.6 CLEANING

A. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign materials from exposed interior and exterior surfaces.

B. Wash and shine glazing.

C. Polish glossy surfaces to a clean shine.

3.7 CHECK-OUT PROCEDURES

A. Check installed products before continuity tests, leak tests, and calibration.

B. Check temperature instruments for proper location and accessibility.
C. Verify sensing element type and proper material.
D. Verify location and length.
E. Verify that wiring is correct and secure.

3.8 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Perform according to manufacturer's written instruction.
   2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Prepare test and inspection reports.

3.9 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain temperature instruments.

END OF SECTION 230923.27
SECTION 232113 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes pipe and fitting materials and joining methods for the following:
   1. Copper pipe and fittings.
   2. Steel pipe and fittings.
   3. Plastic pipe and fittings.
   5. Dielectric fittings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of the following:
   1. Pipe.
   2. Fittings.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.4 QUALITY ASSURANCE


PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:
   1. Hot-Water Heating Piping: 100 psig at 200 deg F.
   2. Chilled-Water Piping: 150 psig at 73 deg F.
   3. Condensate-Drain Piping: 150 deg F.
   4. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.
2.2 COPPER TUBE AND FITTINGS
   A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.
   B. DWV Copper Tubing: ASTM B 306, Type DWV.
   C. Wrought-Copper Unions: ASME B16.22.

2.3 STEEL PIPE AND FITTINGS
   A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; welded and seamless, Grade B, and wall thickness as indicated in "Piping Applications" Article.
   B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in "Piping Applications" Article.
   D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in "Piping Applications" Article.
   E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in "Piping Applications" Article.
   F. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
      2. End Connections: Butt welding.
      3. Facings: Raised face.

2.4 PLASTIC PIPE AND FITTINGS
   A. PVC Plastic Pipe: ASTM D 1785, with wall thickness as indicated in "Piping Applications" Article.

2.5 JOINING MATERIALS
   A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
      1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless otherwise indicated.
         a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

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

2.6 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Description:
   b. Pressure Rating: 125 psig minimum at 180 deg F (82 deg C).
   c. End Connections: Solder-joint copper alloy and threaded ferrous.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Hot-water heating piping, aboveground, NPS 2 and smaller, shall be the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered brazed pressure-seal joints.

B. Hot-water heating piping, aboveground, NPS 2-1/2 and larger, shall be the following:

1. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.

C. Chilled-water piping, aboveground, NPS 2 and smaller, shall be the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered brazed pressure-seal joints.

D. Chilled-water piping, aboveground, NPS 2-1/2 and larger, shall be the following:
1. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.

E. Condensate-Drain Piping: Type DWV, drawn-temper copper tubing, wrought-copper fittings, and soldered joints or Schedule 40 PVC plastic pipe and fittings and solvent-welded joints.

F. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.

3.2 PIPING INSTALLATIONS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

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

C. 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.

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

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

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

I. Install piping to allow application of insulation.

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

K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
O. Install branch connections to mains using mechanically formed tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.

P. Install valves according to the following:

1. Section 230523.11 "Globe Valves for HVAC Piping."
2. Section 230523.12 "Ball Valves for HVAC Piping."
3. Section 230523.13 "Butterfly Valves for HVAC Piping."
4. Section 230523.14 "Check Valves for HVAC Piping."
5. Section 230523.15 "Gate Valves for HVAC Piping."

Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

S. Install shutoff valve immediately upstream of each dielectric fitting.

T. Comply with requirements in Section 230516 "Expansion Fittings and Loops for HVAC Piping" for installation of expansion loops, expansion joints, anchors, and pipe alignment guides.

U. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for identifying piping.

V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.3 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.

3.4 HANGERS AND SUPPORTS

A. Comply with requirements for seismic-restraint devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
B. Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hangers, supports, and anchor devices.

C. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.

D. Install hangers for copper tubing and steel piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

E. Support vertical runs of copper tubing and steel piping to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

F. Install hangers for plastic piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced code, and authorities having jurisdiction requirements, whichever are most stringent.

G. Support horizontal piping within 12 inches of each fitting and coupling

3.5 PIPE JOINT CONSTRUCTION

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

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. 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.

D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8/A5.8M.

E. 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.

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

G. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
3. PVC Pressure Piping: Join ASTM D 1785 schedule number, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule number PVC pipe and socket fittings according to ASTM D 2855.
4. PVC Nonpressure Piping: Join according to ASTM D 2855.

H. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.

I. Plain-End Mechanical-Coupled Joints: Prepare, assemble, and test joints in accordance with manufacturer's written installation instructions.

J. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.

3.6 TERMINAL EQUIPMENT CONNECTIONS

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install control valves in accessible locations close to connected equipment.

C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.

D. Install ports for pressure gages and thermometers at coil inlet and outlet connections. Comply with requirements in Section 230519 "Meters and Gages for HVAC Piping."

3.7 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.

5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.

2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.

3. Isolate expansion tanks and determine that hydronic system is full of water.

4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times the "SE" value in Appendix A in ASME B31.9, "Building Services Piping."

5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.

6. Prepare written report of testing.

C. Perform the following before operating the system:

1. Open manual valves fully.

2. Inspect pumps for proper rotation.

3. Set makeup pressure-reducing valves for required system pressure.

4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).

5. Set temperature controls so all coils are calling for full flow.

6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.

7. Verify lubrication of motors and bearings.

END OF SECTION 232113
SECTION 232116 - HYDRONIC PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Hydronic specialty valves.
   2. Air-control devices.
   3. Strainers.
   4. Connectors.

B. Related Requirements:
   1. Section 230523.11 "Globe Valves for HVAC Piping" for specification and installation requirements for globe valves common to most piping systems.
   2. Section 230523.12 "Ball Valves for HVAC Piping" for specification and installation requirements for ball valves common to most piping systems.
   3. Section 230523.13 "Butterfly Valves for HVAC Piping" for specification and installation requirements for butterfly valves common to most piping systems.
   4. Section 230523.14 "Check Valves for HVAC Piping" for specification and installation requirements for check valves common to most piping systems.
   5. Section 230523.15 "Gate Valves for HVAC Piping" for specification and installation requirements for gate valves common to most piping systems.
   6. Section 230923.11 "Control Valves" for automatic control valve and sensor specifications, installation requirements, and locations.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product:
   1. Include construction details and material descriptions for hydronic piping specialties.
   2. Include rated capacities, operating characteristics, and furnished specialties and accessories.
   3. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.
1.4 QUALITY ASSURANCE

A. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

B. Safety Valves and Pressure Vessels: Shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

PART 2 - PRODUCTS

2.1 HYDRONIC SPECIALTY VALVES

A. Bronze, Calibrated-Orifice, Balancing Valves:

1. Body: Bronze, ball or plug type with calibrated orifice or venturi.
2. Ball: Brass or stainless steel.
3. Plug: Resin.
4. Seat: PTFE.
5. End Connections: Threaded or socket.
7. Handle Style: Lever, with memory stop to retain set position.
8. CWP Rating: Minimum 125 psig.
9. Maximum Operating Temperature: 250 deg F.

2.2 AIR-CONTROL DEVICES

A. Manual Air Vents:

1. Body: Bronze.
2. Internal Parts: Nonferrous.
3. Operator: Screwdriver or thumbscrew.
4. Inlet Connection: NPS 1/2.
7. Maximum Operating Temperature: 225 deg F.

2.3 STRAINERS

A. Y-Pattern Strainers:

1. Body: ASTM A126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
2.4 CONNECTORS

A. Stainless-Steel Bellow, Flexible Connectors:
   2. End Connections: Threaded or flanged to match equipment connected.
   4. CWP Rating: 150 psig.
   5. Maximum Operating Temperature: 250 deg F.

PART 3 - EXECUTION

3.1 VALVE APPLICATIONS

A. Install shutoff-duty valves at each branch connection to supply mains and at supply connection to each piece of equipment.

B. Install throttling-duty valves at each branch connection to return main.

C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.

3.2 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

END OF SECTION 232116
SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Single-wall rectangular ducts and fittings.
   2. Single-wall round ducts and fittings.
   4. Duct liner.
   5. Sealants and gaskets.
   6. Hangers and supports.

B. Related Sections:
   1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
   2. Section 233119 "HVAC Casings" for factory- and field-fabricated casings for mechanical equipment.
   3. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of the following products:
   1. Liners and adhesives.
   2. Sealants and gaskets.

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 and vibration isolation.

1.4 INFORMATIONAL SUBMITTALS
A. Coordination Drawings: A single set of plans or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.
B. Welding certificates.
C. Field quality-control reports.

1.5 QUALITY ASSURANCE
A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS
A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
B. Transverse Joints: Fabricate joints in accordance with 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."
C. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular 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."
D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 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."

2.2 SINGLE-WALL ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate in accordance with 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."

1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

C. Longitudinal Seams: Select seam types and fabricate in accordance with 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."

1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.

D. Tees and Laterals: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and 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."

2.3 SHEET METAL MATERIALS

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

B. Galvanized Sheet Steel: Comply with ASTM A653/A653M.

2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Reinforcement Shapes and Plates: ASTM A36/A36M, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
2.4 ACOUSTIC DUCT LINER

A. Flexible Elastomeric Duct Liner: Preformed, cellular, closed-cell, sheet materials complying with ASTM C 534, Type II, Grade 1; and with NFPA 90A or NFPA 90B.

1. Basis of Design: Subject to compliance with requirements, provide Armacell LLC. or approved equal.
2. Thickness: 1-inch, unless indicated otherwise on drawings.
3. Thermal Conductivity (k-Value): 0.24 at 75 deg F mean temperature.
4. Noise Reduction Coefficient: 0.40 at 1-inch thickness. Sound absorption coefficients as tested on an Acoustical Materials Association Standard A-type mounting in accordance with ASTM Standard C423:

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<th>Lining Thickness</th>
<th>125</th>
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<td>.62</td>
<td>.44</td>
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5. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
6. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
   a. 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).

2.5 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 in accordance with UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: 3 inches.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
10. Sealant shall have a VOC content of 420 g/L or less.
11. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of
C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
10. Sealant shall have a VOC content of 420 g/L or less.
11. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
12. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
13. Service: Indoor or outdoor.
14. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C920.

2. Type: S.
3. Grade: NS.
5. Use: O.
6. Sealant shall have a VOC content of 420 g/L or less.
7. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

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

F. Round Duct Joint O-Ring Seals:

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

A. Hanger Rods for Noncorrosive Environments: Galvanized-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 A603.

E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A492.

F. Steel Cable End Connections: Galvanized-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.

PART 3 - EXECUTION

3.1 EXTENT OF SOUND LINING

A. As a minimum, ducts from/to heating, ventilating and air conditioning units for a distance of fifteen feet (15') from the units shall be acoustically lined. Supply ducts from VAV boxes units to air devices shall be acoustically lined as noted on drawings.

3.2 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and coordination drawings.

B. Install ducts in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install ducts in maximum practical lengths with fewest possible joints.
D. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

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

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

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

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

I. 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.

J. Install fire and smoke dampers where indicated on Drawings and as required by code, and by local authorities having jurisdiction. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers and specific installation requirements of the damper UL listing.

K. Install heating coils, cooling coils, air filters, dampers, and all other duct-mounted accessories in air ducts where indicated on Drawings.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials both before and after installation. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

3.3 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.
3.4 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Seal ducts at a minimum to the following seal classes in accordance with 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.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
3.6 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."

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

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:
   2. Test the following systems:
      a. Ducts with a Pressure Class Higher Than 3-Inch wg: Test representative duct sections totaling no less than 25 percent of total installed duct area for each designated pressure class.
   3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
   4. Testing of each duct section is to be performed with access doors, coils, filters, dampers, and other duct-mounted devices in place as designed. No devices are to be removed or blanked off so as to reduce or prevent additional leakage.
   5. Test for leaks before applying external insulation.
   6. 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.
   7. Give seven days' advance notice for testing.

C. 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 in accordance with "Description of Method 3 - NADCA Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
      a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

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

E. Prepare test and inspection reports.
3.8 DUCT CLEANING

A. Clean new duct system(s) before testing, adjusting, and balancing.

B. For cleaning of existing ductwork, see Section 230130.52 "Existing HVAC Air Distribution System Cleaning."

C. Use duct cleaning methodology as indicated in NADCA ACR.

D. Use service openings for entry and inspection.
   1. Provide openings with access panels appropriate for duct static-pressure and leakage class at dampers, coils, and any other locations where required for inspection and cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 233300 "Air Duct Accessories" for access panels and doors.
   2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
   3. Remove and reinstall ceiling to gain access during the cleaning process.

E. 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.

F. 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.

G. 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 in accordance with NADCA ACR. 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 in accordance with manufacturer's written instructions after removal of surface deposits and debris.

3.9 STARTUP

A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.10 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:
   1. Fabricate all ducts to achieve SMACNA pressure class, seal class, and leakage class as indicated below.

B. Supply Ducts:
   1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
      a. Pressure Class: Positive 2-inch wg.
      b. Minimum SMACNA Seal Class: C.
      c. SMACNA Leakage Class for Rectangular: 24.
      d. SMACNA Leakage Class for Round and Flat Oval: 12.
   2. Ducts Connected to Variable-Air-Volume Air-Handling Units:
      a. Pressure Class: Positive 4-inch wg.
      b. Minimum SMACNA Seal Class: A.
      c. SMACNA Leakage Class for Rectangular: 6.
      d. SMACNA Leakage Class for Round and Flat Oval: 3.
   3. Ducts Connected to Equipment Not Listed Above:
      a. Pressure Class: Positive 3-inch wg.
      b. Minimum SMACNA Seal Class: B.
      c. SMACNA Leakage Class for Rectangular: 12.
      d. SMACNA Leakage Class for Round and Flat Oval: 6.

C. Return Ducts:
   1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
a. Pressure Class: Positive or negative 2-inch wg.
b. Minimum SMACNA Seal Class: C.
c. SMACNA Leakage Class for Rectangular: 24.
d. SMACNA Leakage Class for Round and Flat Oval: 12.

2. Ducts Connected to Air-Handling Units:
   a. Pressure Class: Positive or negative 3-inch wg.
   b. Minimum SMACNA Seal Class: B.
   c. SMACNA Leakage Class for Rectangular: 12.
   d. SMACNA Leakage Class for Round and Flat Oval: 6.

3. Ducts Connected to Equipment Not Listed above:
   a. Pressure Class: Positive or negative 3-inch wg.
   b. Minimum SMACNA Seal Class: B.
   c. SMACNA Leakage Class for Rectangular: 12.
   d. SMACNA Leakage Class for Round and Flat Oval: 6.

D. Exhaust Ducts:
   1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
      a. Pressure Class: Negative 2-inch wg.
      b. Minimum SMACNA Seal Class: C if negative pressure, and A if positive pressure.
      c. SMACNA Leakage Class for Rectangular: 24.
      d. SMACNA Leakage Class for Round and Flat Oval: 12.
   2. Ducts Connected to Equipment Not Listed above:
      a. Pressure Class: Positive or negative 3-inch wg.
      b. Minimum SMACNA Seal Class: A if negative pressure; A if positive pressure.
      c. SMACNA Leakage Class for Rectangular: 6.
      d. SMACNA Leakage Class for Round and Flat Oval: 6.

E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:
   1. Ducts Connected to Air-Handling Units:
      a. Pressure Class: Positive or negative 3-inch wg.
      b. Minimum SMACNA Seal Class: B.
      c. SMACNA Leakage Class for Rectangular: 12.
      d. SMACNA Leakage Class for Round and Flat Oval: 6.
   2. Ducts Connected to Equipment Not Listed Above:
      a. Pressure Class: Positive or negative 3-inch wg.
      b. Minimum SMACNA Seal Class: B.
      c. SMACNA Leakage Class for Rectangular: 12.
      d. SMACNA Leakage Class for Round and Flat Oval: 6.
F. Intermediate Reinforcement:


G. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
   a. Velocity 1000 fpm or Lower:
      1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
      2) Mitered Type RE 4 without vanes.
   b. Velocity 1000 to 1500 fpm:
      1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
      2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
      3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
   c. Velocity 1500 fpm or Higher:
      1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
      2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
      3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

2. 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-diameter ratio.
   b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
   c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

3. 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 and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
      1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
4) Radius-to Diameter Ratio: 1.5.

b. Round Elbows, 12Inches and Smaller in Diameter: Stamped or pleated.
c. Round Elbows, 14Inches and Larger in Diameter: Welded.

H. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
   a. Rectangular Main to Rectangular Branch: 45-degree entry.
   b. Rectangular Main to Round Branch: Conical spin in.

2. Round and Flat Oval: 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 1000 fpm or Lower: 90-degree tap.
   b. Velocity 1000 to 1500 fpm: Conical tap.
   c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 233113
SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Backdraft and pressure relief dampers.
   3. Air traffic silencers
   4. Flange connectors.
   5. Turning vanes.
   6. Duct-mounted access doors.
   7. Flexible connectors.
   8. Duct accessory hardware.

B. Related Requirements:
   1. Section 233346 "Flexible Ducts" for insulated and non-insulated flexible ducts.
   2. Section 284621.11 "Addressable Fire-Alarm Systems" for duct-mounted fire and smoke detectors.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
   1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
      a. Special fittings.
      c. Fire-damper and smoke-damper installations, including sleeves; and duct-mounted access doors.
      d. Wiring Diagrams: For power, signal, and control wiring.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.
PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION


B. 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.

2.2 MATERIALS

A. Galvanized Sheet Steel: Comply with ASTM A653/A653M.

   2. Exposed-Surface Finish: Mill phosphatized.

B. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

2.3 BACKDRAFT AND PRESSURE RELIEF DAMPERS

A. Description: Gravity balanced.

B. Maximum Air Velocity: 1250 fpm.

C. Maximum System Pressure: 2-inch wg.

D. Frame: Hat-shaped, 0.094-inch-thick, galvanized sheet steel, with welded corners or mechanically attached.

E. Blades: Multiple single-piece blades, center pivoted, maximum 6-inch width, 0.050-inch-thick aluminum sheet with sealed edges.

F. Blade Action: Parallel.

G. Blade Seals: Neoprene, mechanically locked.

H. Blade Axles:

   1. Material: Galvanized steel.
   2. Diameter: 0.20 inch.

I. Tie Bars and Brackets: Galvanized steel.

J. Return Spring: Adjustable tension.
K. Bearings: Steel ball or synthetic pivot bushings.

L. Accessories:

1. Adjustment device to permit setting for varying differential static pressure.
2. Counterweights and spring-assist kits for vertical airflow installations.
3. Electric actuators.
4. Chain pulls.
5. Screen Mounting: Front mounted in sleeve.
   a. Sleeve Thickness: 20 gauge minimum.
   b. Sleeve Length: 6 inches minimum.

6. Screen Mounting: Rear mounted.
7. Screen Material: Aluminum.
8. Screen Type: Bird.
9. 90-degree stops.

2.4 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

1. Standard leakage rating, with linkage outside airstream.
2. Suitable for horizontal or vertical applications.
3. Frames:
   a. Frame: Hat-shaped, 0.094-inch-thick, galvanized sheet steel.
   b. Mitered and welded corners.
   c. Flanges for attaching to walls and flangeless frames for installing in ducts.

4. Blades:
   a. Multiple or single blade.
   b. Parallel- or opposed-blade design.
   c. Stiffen damper blades for stability.
   d. Galvanized-steel, 0.064 inch thick.

6. Bearings:
   a. Molded synthetic.
   b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

7. Tie Bars and Brackets: Galvanized steel.

2.5 AIR TRANSFER SILENCERS

A. Quality Assurance
1. Air transfer silencers shall be installed in accordance with NFPA 90A and with NFPA 90B.
2. Air transfer silencer performance must have been substantiated in a NVLAP test facility in accordance with ASTM E477.
3. Test facilities and reports shall be open to inspection from project engineer.

B. Warranty
   1. Provide 12 month manufacturer warranty from date of shipment for duct air transfer silencers.

2.6 FLANGE CONNECTORS
   A. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
   B. Material: Galvanized steel.
   C. Gauge and Shape: Match connecting ductwork.

2.7 TURNING VANES
   A. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
   B. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
   C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vaness and Vane Runners," and 4-4, "Vane Support in Elbows."
   D. Vane Construction: Single wall.

2.8 DUCT-MOUNTED ACCESS DOORS
      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-by-1-inch 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.

3. Number of Hinges and Locks:
   a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
   b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
   c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
   d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

2.9 FLEXIBLE CONNECTORS

A. Materials: Flame-retardant or noncombustible fabrics.

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

C. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two 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.

2.10 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts.
B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel.

C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts.

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

F. Install test holes at fan inlets and outlets and elsewhere as indicated.

G. Install air transfer silencers according to manufacturer’s written installation instructions.

H. Support duct air transfer silencers independently from ductwork.

I. Ensure duct air transfer silencers are installed with airflow arrows in direction of airflow.

J. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. On both sides of duct coils.
2. Upstream and downstream from duct filters.
3. At outdoor-air intakes and mixed-air plenums.
4. At drain pans and seals.
5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
6. 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.
7. At each change in direction and at maximum 50-foot spacing.
8. Upstream and downstream from turning vanes.
9. Upstream or downstream from duct silencers.
10. Control devices requiring inspection.
11. Elsewhere as indicated.

K. Install access doors with swing against duct static pressure.

L. Access Door Sizes:

1. One-Hand or Inspection Access: 8 by 5 inches.
2. Two-Hand Access: 12 by 6 inches.

M. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
N. Install flexible connectors to connect ducts to equipment.

O. Install duct test holes where required for testing and balancing purposes.

3.2 FIELD QUALITY CONTROL

A. 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. Operate fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.

END OF SECTION 233300
SECTION 233346 - FLEXIBLE DUCTS

PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes:
   1. Insulated flexible ducts.

1.2 ACTION SUBMITTALS
A. Product Data: For each type of product.
B. Shop Drawings: For flexible ducts.
   1. Include plans showing locations and mounting and attachment details.

1.3 INFORMATIONAL SUBMITTALS
A. Coordination Drawings: Reflected ceiling plans, drawn to scale, and coordinated with each other, using input from installers of the items involved.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION
B. 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.
C. Comply with the Air Diffusion Council's "ADC Flexible Air Duct Test Code FD 72-R1."

2.2 INSULATED FLEXIBLE DUCTS
A. Basis of Design: Subject to compliance with requirements, provide Flexmaster U.S.A., Type IM Acoustical Insulated Flexible duct or approved equal.
B. Insulated, Flexible Duct: UL 181, Class 1, polyethylene fabric mechanically locked to galvanized steel, helically wound wire.
   1. Pressure Rating: 10-inch wg positive and 5-inch wg negative.
   3. Temperature Range: Minus 20 to plus 250 deg F.
   4. Insulation: R6 Fiberglass ball insulation with reinforced metalized vapor barrier.
   5. Vapor Barrier Permeance: 0.05 perm, tested per ASTM E96, Procedure A.

2.3 FLEXIBLE DUCT CONNECTORS

A. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install flexible ducts according to applicable details in SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install in indoor applications only. Flexible ductwork should not be exposed to UV lighting.

C. Connect terminal units to supply ducts with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.

D. Connect diffusers or light troffer boots to ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.

E. Connect flexible ducts to metal ducts with draw bands.

F. Install duct test holes where required for testing and balancing purposes.

G. Installation:
   1. Install ducts fully extended.
   2. Do not bend ducts across sharp corners.
   3. Bends of flexible ducting shall not exceed a minimum of one duct diameter.
   4. Avoid contact with metal fixtures, water lines, pipes, or conduits.
   5. Install flexible ducts in a direct line, without sags, twists, or turns.

H. Supporting Flexible Ducts:
   1. Suspend flexible ducts with bands 1-1/2 inches wide or wider and spaced a maximum of 48 inches apart. Maximum centerline sag between supports shall not exceed 1/2 inch per 12 inches.
2. Install extra supports at bends placed approximately one duct diameter from center line of the bend.
3. Ducts may rest on ceiling joists or truss supports. Spacing between supports shall not exceed the maximum spacing per manufacturer's written installation instructions.
4. Vertically installed ducts shall be stabilized by support straps at a maximum of 72 inches o.c.

END OF SECTION 233346
SECTION 233416 - CENTRIFUGAL HVAC FANS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Square in-line centrifugal fans.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:
   1. Include plans, elevations, sections, and attachment details.
   2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Include diagrams for power, signal, and control wiring.
   4. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Fan room layout and relationships between components and adjacent structural and mechanical elements, drawn to scale, and coordinated with each other, using input from installers of the items involved.

B. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 BELT DRIVEN CENTRIFUGAL INLINE FANS

A. General Description:
   1. Base fan performance at standard conditions (density 0.075 Lb/ft3)
2. Normal operating temperature up to 180 Fahrenheit (82.2 Celsius)
3. Applications include: intake, exhaust, return, or make-up air systems
4. Each fan shall bear a permanently affixed manufacture's engraved metal nameplate containing the model number and individual serial number

B. Wheel:
   1. Non-overloading, backward inclined centrifugal wheel
   2. Statically and dynamically balanced in accordance to AMCA Standard 204-05
   3. The wheel cone and fan inlet will be matched and shall have precise running tolerances for maximum performance and operating efficiency
   4. Single thickness blades are securely riveted or welded to a heavy gauge back plate and wheel cone

C. Motors:
   1. AC Induction Motor
      a. Motor Enclosure: Open drip proof (ODP) - opening in the frame body and or end brackets
      b. Motors are permanently lubricated, heavy duty ball bearing type to match with the fan load and pre-wired to the specific voltage and phase

D. Shaft and Bearings:
   1. Fan Shaft shall be ground and polished solid steel with an anti-corrosive coating
   2. Permanently sealed bearings or pillow block ball bearings
   3. Bearing shall be selected for a minimum L10 life in excess of 100,000 hours (equivalent to L50 average life of 500,000 hours), at maximum cataloged operating speed
   4. Fan Shaft first critical speed is at least 25 percent over maximum operating speed

E. Housing/Cabinet Construction:
   1. Square design constructed of heavy gauge galvanized steel and shall include square duct mounting collars
   2. Housing and bearing supports shall be constructed of heavy gauge bolted and welded steel construction to prevent vibration and to rigidly support the shaft and bearing assembly.

F. Housing Supports and Drive Frame:
   1. Housing supports are constructed of structural steel with formed flanges
   2. Drive frame is welded steel which supports the shaft and bearings and reinforcement for the housing
   3. Pivoting motor plate with adjusting screws to make belt tensioning operations

G. Disconnect Switches:
   1. Positive electrical shut-off
   2. Wired from fan motor to junction box installed within motor compartment
H. Drive Assembly:
   1. Belts, pulleys, and keys oversized for a minimum of 150 percent of driven horsepower
   2. Belt: Static free and oil resistant
   3. Pulleys: Cast type, keyed, and securely attached to wheel and motor shafts
   4. Motor pulleys are adjustable for final system balancing
   5. Readily accessible for maintenance

I. Duct Collars:
   1. Square design to provide a large discharge area
   2. Inlet and discharge collars provide easy duct connection

J. Access Panel:
   1. Two sided access panels, permit easy access to all internal components
   2. Located perpendicular to the motor mounting panel

K. Options/Accessories:
   1. Belt Guards:
      a. Three-sided fabricated steel belt guard covers drive and motor
   2. Belt Type:
      a. Standard Belt
   3. Extended Bearing Lube Lines:
      a. Grease zerks on housing exterior allows for lubrication of bearings without disassembling the fan
   4. Side Discharge: Flange connector and attachment hardware to provide right-angle discharge on side of unit.

2.2 DIRECT DRIVEN BACKWARD INCLINED CENTRIFUGAL INLINE FAN(S)

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Greenheck.
   2. Loren Cook Company.
   3. Penn Ventilation.

B. General Description:
   1. Normal operating temperature up to 130 Fahrenheit.
2. Each fan shall bear a permanently affixed manufacturer's engraved metal nameplate containing the model number and individual serial number.

C. Wheel:
   1. Non-overloading, backward inclined centrifugal wheel
   2. Constructed of aluminum
   3. Statically and dynamically balanced in accordance to AMCA Standard 204-05
   4. The wheel cone and fan inlet will be matched and shall have precise running tolerances for maximum performance and operating efficiency
   5. Single thickness blades are securely riveted or welded to a heavy gauge back plate and wheel cone.

D. Motors:
   1. Electronically Commutated Motor
      a. Motor enclosures: Open type
      b. Motor to be a DC electronic commutation type motor (ECM) specifically designed for fan applications. AC induction type motors are not acceptable. Examples of unacceptable motors are: Shaded Pole, Permanent Split Capacitor (PSC), Split Phase, Capacitor Start and 3 phase induction type motors.
      c. Motors are permanently lubricated, heavy duty ball bearing type to match with the fan load and pre-wired to the specific voltage and phase.
      d. Internal motor circuitry to convert AC power supplied to the fan to DC power to operate the motor.
      e. Motor shall be speed controllable down to 20% of full speed (80% turndown). Speed shall be controlled by either a potentiometer dial mounted at the motor or by a 0-10 VDC signal.
      f. Motor shall be a minimum of 85% efficient at all speeds.

E. Housing/Cabinet Construction
   1. Construction material: Galvanized
   2. Square design constructed of heavy gauge galvanized steel and shall include square duct mounting collars
   3. Housing and bearing supports shall be constructed of heavy gauge bolted and welded steel construction to prevent vibration and to rigidly support the shaft and bearing assembly.

F. Housing Supports and Drive Frame:
   1. Housing supports are constructed of structural steel with formed flanges
   2. Drive frame is welded steel which supports the motor

G. Duct Collars:
   1. Inlet and discharge collars provide easy duct connection

H. Access Panel:
1. Two sided access panels, permit easy access to all internal components
2. Located perpendicular to the motor mounting panel

I. Accessories:

1. Dampers:
   a. Types: Gravity
   b. Galvanized frames with prepunched mounting holes
   c. Balanced for minimal resistance to flow
   d. Coating type: Permatector or equivalent

2. Insulated Housing
   a. Thickness: 1 inches
   b. For noise reduction and condensation control
   c. Constructed of fiberglass liner

3. Isolation:
   a. Type: Spring isolators
   b. Sized to match the weight of each fan

4. Motor Cover:
   a. Constructed of galvanized steel
   b. Covers motor and drives for safety
   c. Standard on unit specified with UL

5. Pressure Probe:
   a. ¼ inch diameter tube in fan venturi that allows hook up to manometer

6. Wiring Pigtail:
   a. Direct hook-up to the power supply

7. Time delay (adj)

2.3 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

B. Where variable-frequency drives are indicated or scheduled, provide fan motor compatible with variable-frequency drive.
2.4 SOURCE QUALITY CONTROL

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

B. AMCA Compliance: Fans shall comply with AMCA 11 and bear the AMCA-Certified Ratings Seal.

C. Fan Sound Ratings: Comply with AMCA 311 and label fans with the AMCA-Certified Ratings Seal. Sound ratings shall comply with AMCA 301. The fans shall be tested according to AMCA 300.

D. Fan Performance Ratings: Comply with AMCA 211 and label fans with AMCA-Certified Rating Seal. The fans shall be tested for air performance - flow rate, fan pressure, power, fan efficiency, air density, speed of rotation, and fan efficiency - according to AMCA 210/ASHRAE 51.

E. Operating Limits: Classify fans according to AMCA 99.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive fans. Notify the Engineer of conditions that would adversely affect installation or subsequent utilization and maintenance of fans. Do not proceed with installation until unsatisfactory conditions are corrected.

3.2 INSTALLATION OF CENTRIFUGAL HVAC FANS

A. Install centrifugal fans level and plumb.

B. Install fans in accordance with manufacturer's instructions.

C. Disassemble and reassemble units, as required for moving to the final location, according to manufacturer's written instructions.

D. Lift and support units with manufacturer's designated lifting or supporting points.

E. Equipment Mounting:
   1. Support duct-mounted and other hanging centrifugal fans directly from the building structure, using suitable hanging systems as specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
   2. Comply with requirements for vibration isolation and seismic-control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

F. Install units with clearances for service and maintenance.
G. Label fans according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.3 DUCTWORK AND PIPING CONNECTIONS

A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 233300 "Air Duct Accessories."

B. Install ducts adjacent to fans to allow service and maintenance.

C. Install piping from scroll drain connection, with trap with seal equal to 1.5 times specified static pressure, to nearest floor drain with pipe sizes matching the drain connection.

D. Install heat tracing on all drain piping subject to freezing temperature and as indicated on Drawings. Furnish and install heat tracing according to Section 230533 "Heat Tracing for HVAC Piping."

3.4 ELECTRICAL CONNECTIONS

A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.
   1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."
   2. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

3.5 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring according to Section 260523 "Control-Voltage Electrical Power Cables."

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:
1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that there is adequate maintenance and access space.
4. Verify that cleaning and adjusting are complete.
5. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
6. Adjust belt tension.
7. Adjust damper linkages for proper damper operation.
8. Verify lubrication for bearings and other moving parts.
9. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
10. See Section 230593 "Testing, Adjusting, and Balancing For HVAC" for testing, adjusting, and balancing procedures.
11. Remove and replace malfunctioning units and retest as specified above.

D. Test and adjust controls and safeties. Controls and equipment will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.7 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.

D. Replace fan and motor pulleys as required to achieve design airflow.

E. Lubricate bearings.

3.8 DEMONSTRATION

A. Owner's maintenance personnel to adjust, operate, and maintain centrifugal fans.

END OF SECTION 233416
SECTION 233600 - AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Shutoff, single-duct air terminal units.
   2. Series, fan-powered air terminal units.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of air terminal unit.

B. Shop Drawings: For air terminal units.
   1. Include plans, elevations, sections, and mounting details.
   2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Include diagrams for power, signal, and control wiring.
   4. Hangers and supports, including methods for duct and building attachment and vibration isolation.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

B. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

C. ASHRAE Compliance: Applicable requirements in ASHRAE/IES 90.1, "Section 6 - Heating, Ventilating, and Air Conditioning."

2.2 SHUTOFF, SINGLE-DUCT AIR TERMINAL UNITS

A. Terminals shall be certified under the ARI Standard 880 Certification Program and carry the ARI Seal. Noncertified terminals may be submitted after testing at an independent testing laboratory under conditions selected by the engineering consultant in full compliance with ARI Standard 880. These tests must be witnessed by the engineering consultant with all costs to be borne by the terminal manufacturer. Testing does not ensure acceptance.

B. The terminal casing shall be minimum 22-gauge galvanized steel, internally lined with ½-inch dual density insulation which complies with UL 181 and NFPA 90A. All exposed insulation edges shall be coated with NFPA 90A approved sealant to prevent entrainment of fibers in the airstream. The discharge connection shall be slip and drive construction for attachment to metal ductwork. The casing shall be constructed to hold leakage to the maximum values shown in the Casing Leakage table.

C. The damper shall be heavy gauge steel with shaft rotating in self-lubricating bearings. Nylon bearings are not acceptable. Shaft shall be clearly marked on the end to indicate damper position. Stickers or other removable markings are not acceptable. The damper shall incorporate a mechanical stop to prevent overstroke and a synthetic seal to limit close-off leakage to the maximum values shown in the Damper Leakage table.

D. Actuators shall be capable of supplying at least 35-inch lbs. of torque to the damper shaft and shall be mounted externally for service access. Terminals with internal actuator mounting or linkage connection must include gasketed access panel, removable without disturbing ductwork. Casing with access panel shall be constructed to hold leakage to the maximum values shown in the Casing Leakage table.

E. At an inlet velocity of 2000 fpm, the minimum static pressure required to operate any terminal size shall not exceed 0.13-inch wg for the basic terminal.

F. Sound ratings for the terminal shall not exceed ____ NC at ____ static pressure. Sound performance shall be ARI certified.

G. Accessories

1. Hot Water Reheat Coils

   a. Hot water reheat coils shall be enclosed in a minimum 20-gauge galvanized steel casing with slip and drive construction for attachment to metal ductwork. Coils shall be factory installed on the terminal discharge. Fins shall be rippled and corrugated heavy gauge aluminum, mechanically bonded to tubes. Tubes shall be copper with minimum wall thickness of 0.016-inch with male solder header connections. Coils shall be leak tested to 300 psi with minimum burst pressure of 1800 psi at ambient temperature. Number of coil rows and circuits shall be selected.
to provide performance as required per the plans. Coil performance data shall be based on tests run in accordance with ARI Standard 410.

2.3 SERIES FAN-POWERED AIR TERMINAL UNITS

A. Basis of Design: Subject to compliance with requirements, provide Titus Fantom IQ or approved equal by one for the following:

1. Price.
2. Enviro-Tech.

B. Furnish and install TITUS Model (P)(A)(D)TFS series flow fan powered terminals of the sizes and capacities shown on the plans. Space limitations shall be reviewed carefully to ensure that all terminals will fit the available space.

C. Terminals should be certified under the ARI Standard 880 Certification Program and carry the ARI Seal. Non-certified terminals may be submitted after testing at an independent testing laboratory under conditions selected by the engineer in full compliance with ARI Standard 880. These tests must be witnessed by the engineering consultant with all costs to be borne by the terminal manufacturer. Testing does not ensure acceptance.

D. The terminal shall be designed, built, and tested as a single unit including motor and fan assembly, primary air damper assembly, water or electric heating coils, and accessories as shipped. Unit shall ship as a complete assembly requiring no field assembly (including accessories). All electrical components shall be UL listed and installed in accordance with the UL Standard 1995. Electrical connection shall be single point. All electrical components, including low voltage controls, shall be mounted in sheet metal control enclosures. The entire terminal shall be ETL listed as a complete assembly.

E. The terminal casing shall be minimum 20-gauge galvanized steel, internally lined with ½-inch dual density insulation that complies with UL 181 and NFPA 90A. The casing shall be designed for hanging by sheet metal brackets. The terminal shall have a round duct collar for the primary air connection and a centered rectangular discharge suitable for flanged duct connection.

F. The terminal casing shall have two top and two bottom access panels, which allows removal of fan assembly and servicing of terminal without disturbing duct connections. The terminal shall have internal and external attenuators factory installed. The external attenuator shall be shipped internal to the unit to protect it from shipping damage. The external attenuator shall be slid into the operation position and secured without the need for additional screws. Factory provided attenuators that require field installation are not acceptable.

G. The fan shall be constructed of steel and have a forward curved, dynamically balanced wheel with direct drive motor. The motor shall be of energy efficient design, permanent split capacitor type, with integral thermal overload protection and permanently lubricated bearings, and be specifically designed for use with an SCR for fan speed adjustment. Fan assembly shall include a tuned spring steel suspension and isolation between motor and fan housing.
H. The terminals shall utilize a manual SCR, which allows continuously adjustable fan speed from maximum to minimum, as a means of setting fan airflow. Setting fan airflow with any device that raises the pressure across the fan to reduce airflow is not acceptable. The speed control shall incorporate a minimum voltage stop to ensure that the motor cannot operate in a stall mode.

I. The primary air damper assembly shall be heavy gauge steel with shaft rotating in self-lubricating bearings. Nylon bearings are not acceptable. Shaft shall be clearly marked on the end to indicate damper position. Stickers or other removable markings are not acceptable. The damper shall incorporate a mechanical stop to prevent overstrok ing, and a synthetic seal to limit close-off leakage to the maximum values shown in the following table. Provide a four point, center-averaging differential pressure airflow sensor. A sensor that delivers the differential pressure signal from one end of the sensor is not acceptable. Balancing taps and airflow calibration charts shall be provided for field airflow measurements.

J. Sound performance shall be ARI certified. If NC is provided instead of octave band sound power data, the radiated and discharge path attenuation function for the specified NC shall be based upon factors found in ARI Standard 885-98, Appendix E. No additional attenuation factors shall be deducted from the sound power.

K. The terminal unit manufacturer shall provide a factory installed PWM controller for either manual or DDC controlled fan cfm adjustment. The manual PWM controller shall be field adjustable with a standard screwdriver. The remote PWM controller shall be capable of receiving a 0-10 Vdc signal from the DDC controller (provided by the controls contractor) to control the fan cfm. When the manual PWM controller is used, the factory shall preset the fan cfm as shown on the schedule.

L. Hot Water Heating Coils

1. Hot water heating coils shall be enclosed in a minimum 20-gauge galvanized steel casing, with flanged construction for attachment to metal ductwork. Coils shall be factory installed on the terminal. Fins shall be rippled and corrugated heavy gauge aluminum, mechanically bonded to tubes. Tubes shall be copper with minimum wall thickness of 0.016 inch, with male solder header connections. Coils shall be leak tested to 300 psi, with minimum burst pressure of 1800 psi at ambient temperature. Number of coil rows and circuits shall be selected to provide performance as required per the plans. Coil performance data shall be based on tests run in accordance with ARI Standard 410.

M. Accessories

1. Induced air filter, 1” thick, disposable construction type. Provide 2 sets for each terminal for Towson University stock.
2. Vibration Isolation
PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 5, "Hangers and Supports" and with Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes and for slabs more than 4 inches thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes and for slabs less than 4 inches thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hangers Exposed to View: Threaded rod and angle or channel supports.

D. 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.

3.2 TERMINAL UNIT INSTALLATION

A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.

C. Install wall-mounted thermostats.

D. Where installing piping adjacent to air terminal unit, allow space for service and maintenance.

E. Hot-Water Piping: Comply with requirements in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties," and connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve and union or flange.

F. Comply with requirements in Section 233113 "Metal Ducts" for connecting ducts to air terminal units.

G. Make connections to air terminal units with flexible connectors complying with requirements in Section 233300 "Air Duct Accessories."
H. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for equipment labels and warning signs and labels.

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
2. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Air terminal unit will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.4 DEMONSTRATION

A. Owner's maintenance personnel to adjust, operate, and maintain air terminal units.

END OF SECTION 233600
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Rectangular and square ceiling diffusers.

B. Related Requirements:
   1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers.
   2. Section 233713.23 "Air Registers and Grilles" for adjustable-bar register and grilles, fixed-face registers and grilles, and linear bar grilles.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate air devices according to ASHRAE 70.

PART 2 - PRODUCTS

2.1 SELECTION CRITERIA

A. Air devices shall be selected for 5dB lower than the listed Noise Criteria (NC) of the room it serves.

B. Noise Criteria of Room:
   1. Rooms with 25 NC: Classrooms
   2. Rooms with 35 NC: All other spaces.

2.2 RECTANGULAR AND SQUARE CEILING DIFFUSERS

A. Manufacturers: available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Titus
a. Model TDCA

2. Krueger.
3. METALAIRE, Inc.
5. Nailor
6. Hart and Cooley.

B. Material: Steel backpan and pattern controllers, with steel face.

C. Finish: White.

D. Face Size: Where diffuser is to be installed in a lay-in ceiling, diffuser shall have panels to fit into 24 x 24 modular lay-in ceiling.

E. Mounting: Coordinate the appropriate border and mount for the specific application.

F. Pattern: Square or rectangular pattern with removable directional multi-blade core. Adjustable pattern should be four-way, unless noted otherwise on drawings.

G. Dampers: Opposed blade.

H. Accessories:

1. Provide square to round neck adaptor, if connected to flexible ductwork.
2. Provide diffusers with horizontal to vertical pattern, adjusting tabs and opposed blade damper.

I. Square ceiling diffusers shall be steel. These diffusers shall consist of an outer frame assembly. A square or rectangular inlet shall be an integral part of the frame assembly and a transition piece shall be available to facilitate attachment of round duct. An inner core assembly consisting of fixed deflection louvers. The inner core assembly shall be removable in the field without tools. The finish shall be #26 white. The finish shall be an anodic acrylic paint, baked at 315°F for 30 minutes. The pencil hardness must be HB to H. The paint must pass a 100-hour ASTM B117 Corrosive Environments Salt Spray Test without creepage, blistering or deterioration of film. The paint must pass a 250-hour ASTM D870 Water Immersion Test. The paint must also pass the ASTM D2794 Reverse Impact Cracking Test with a 50-inch pound force applied. Damper shall be constructed of heavy gauge steel. Damper must be operable from the face of the diffuser. The manufacturer shall provide published performance data for the square diffuser. The diffuser shall be tested in accordance with ANSI/ASHRAE Standard 70-2006.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where air devices are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install diffusers level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

A. After installation, adjust diffusers to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713.13
SECTION 233713.23 - REGISTERS AND GRILLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Fixed face registers and grilles.

B. Related Requirements:
   1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to registers and grilles.
   2. Section 233713.13 "Air Diffusers" for various types of air diffusers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate air devices according to ASHRAE 70, “Method of Testing for Rating the performance of Air Outlets and Inlets”.

PART 2 - PRODUCTS

2.1 SUPPLY AIR REGISTERS

A. Supply Air Registers

   1. Manufacturers: available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Titus
         1) Model 301RL
      b. Krueger.
      c. METALAIRE, Inc.
      d. Price Industries.
      e. Nailor
      f. Hart and Cooley.

   2. Mounting: Coordinate the appropriate border and mount for the specific application.
3. Steel supply grilles shall be single deflection. The deflection blades shall be available parallel to the long dimension of the grille. Construction shall be of steel with a 1¼-inch wide border on all sides. Screw holes shall be countersunk for a neat appearance. Corners shall be welded with full penetration resistance welds.

4. Deflection blades shall be contoured to a specifically designed and tested cross-section to meet published test performance data. Blades shall be spaced on ¾-inch centers. Blades shall have steel friction pivots on both ends to allow individual blade adjustment without loosening or rattling. Plastic blade pivots are not acceptable.

5. Opposed-blade volume damper shall be constructed of heavy gauge steel. Damper must be operable from the face of the grille.

6. The grille finish shall be #26 white. The finish shall be an anodic acrylic paint, baked at 315°F for 30 minutes. The pencil hardness must be HB to H. The paint must pass a 100-hour ASTM B117 Corrosive Environments Salt Spray Test without creepage, blistering or deterioration of film. The paint must pass a 250-hour ASTM D870 Water Immersion Test. The paint must also pass the ASTM D2794 Reverse Impact Cracking Test with a 50-inch pound force applied.

7. The manufacturer shall provide published performance data for the grille. The grille shall be tested in accordance with ANSI/ASHRAE Standard 70-1991.

B. Return and Exhaust Registers:

1. Manufacturers: available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Titus

      1) Model 350RL

   b. Krueger.

c. METALAIRE, Inc.
d. Price Industries.
e. Nailor.
f. Hart and Cooley

2. Steel return grilles shall have 3 /4 inch blade spacing. The fixed deflection blades shall be available parallel to the long or short dimension of the grille. Construction shall be of steel with a 1¼-inch wide border on all sides. Screw holes shall be countersunk for a neat appearance. Corners shall be welded with full penetration resistance welds.

3. Face Size: Flush, where registers is to be installed in a lay-in ceiling, register shall have panels to fit into 24 x 24 modular lay-in ceiling.

4. Mounting: Coordinate the appropriate border and mount for the specific application.

5. Deflection blades shall be contoured to a specifically designed and tested cross-section to meet published test performance data. Blades shall be firmly held in place by mullions from behind the grille and fixed to the grille by welding in place. Blade deflection angle shall be available at 35°.

6. Opposed-blade volume damper shall be constructed of heavy gauge steel. Damper must be operable from the face of the grille.

7. The grille finish shall be #26 white. The finish shall be an anodic acrylic paint, baked at 315°F for 30 minutes. The pencil hardness must be HB to H. The paint must pass a 100-hour ASTM B117 Corrosive Environments Salt Spray Test without creepage, blistering or deterioration of film.
8. The paint must pass a 250-hour ASTM D870 Water Immersion Test. The paint must also pass the ASTM D2794 Reverse Impact Cracking Test with a 50-inch pound force applied.


PART 3 - EXECUTION

3.1 INSTALLATION

A. Install registers and grilles level and plumb.

B. Outlets and Inlets Locations: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install registers and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.2 ADJUSTING

A. After installation, adjust registers and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713.23
SECTION 237313.13 - INDOOR, BASIC AIR-HANDLING UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes factory-assembled, indoor air-handling units with limited features, including the following components and accessories:

1. Casings.
2. Fans, drives, and motors.
3. Coils.
4. Air filtration.
5. Dampers.

1.2 ACTION SUBMITTALS

A. Product Data: For each air-handling unit.

B. Shop Drawings: For each type and configuration of indoor, basic, air-handling unit.

1. Include plans, elevations, sections, and details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Detail fabrication and assembly of indoor, basic air-handling units, as well as procedures and diagrams.
4. Include diagrams for power, signal, and control wiring.
5. Computer generated fan curves for each air handling unit shall be submitted with specific design operating point noted.
6. Sound data for discharge, radiated and return positions shall be submitted by octave band for each unit.
7. Calculations for required baserail heights to satisfy condensate trapping requirements of cooling coil shall be included.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans and other details, drawn to scale, showing the items described in this Section, and coordinated with all building trades.

B. Source quality-control reports.

C. Startup service reports.

D. Field quality-control reports.
E. Sample Warranty: For manufacturer's warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air-handling units to include in emergency, operation, and maintenance manuals.

1.5 WARRANTY

A. Warranty: Manufacturer agrees to repair or replace components of indoor, basic, air-handling units that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Manufacturer's standard, but not less than one year from date of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site.

B. Accept products on site on factory-furnished shipping skids. Inspect for damage.

C. Store in clean dry place and protect from construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.

C. ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

D. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

E. Air Handling units shall be cETLus safety listed to conform with UL Standard 1995 and CAN/CSA Standard C22.2 No. 236.

F. Air handler furnished with double width, double inlet (DWDI) fans and/or plenum fans where applicable, shall be certified in accordance with the central station air handling units certification program, which is based on AHRI Standard 430.
G. Air handling unit water heating & cooling coils shall be certified in accordance with the forced circulation air cooling and air heating coils certification program, which is based on AHRI Standard 410.

H. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design vibration isolation, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

I. Structural Performance: Casing panels shall be self-supporting and capable of withstanding positive/negative [4-inch wg] <Insert value> of internal static pressure, without exceeding a midpoint deflection of [0.005 inches/inch] <Insert value> of panel span.

2.2 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

1. Buffalo Air Handling.
2. Carrier Corporation; a unit of United Technologies Corp.
4. Trane.

2.3 UNIT CONSTRUCTION

A. Fabricate unit with heavy gauge channel posts and panels secured with mechanical fasteners. All panels, access doors, and ship sections shall be sealed with permanently applied bulb-type gasket. Shipped loose gasketing is not allowed.

B. Panels and access doors shall be constructed as a 2-inch nominal thick; thermally broken double wall assembly, injected with foam insulation with an R-value of not less than R-13.

1. The inner liner shall be constructed of G90 galvanized steel.
2. The outer panel shall be constructed of G90 galvanized steel.
3. The floor plate shall be constructed as specified for the inner liner.
4. Unit shall be furnished with solid inner liners.

C. Panel deflection shall not exceed L/240 ratio at 125% of design static pressure, maximum 5 inches of positive or 6 inches of negative static pressure. Deflection shall be measured at the panel midpoint.

D. The casing leakage rate shall not exceed 0.50 cfm per square foot of casing surface area at design static pressure up to a maximum of +5” w.c. in positive pressure sections and -6” w.c. in negative pressure sections.

E. Module to module field assembly shall be accomplished with an overlapping, full perimeter internal splice joint that is sealed with bulb type gasketing on both mating modules.
F. Access doors shall be flush mounted to cabinetry, with minimum of two six inch long stainless steel piano-type hinges, latch and full size handle assembly. Access doors shall swing outward for unit sections under negative pressure. Access doors on positive pressure sections, shall have a secondary latch to relieve pressure and prevent injury upon access.

G. A 6-inch high formed G60 galvanized steel base rail shall be provided by the unit manufacturer for structural rigidity and condensate trapping. The base rail shall be constructed of 12-gauge steel.

H. Construct drain pans from stainless steel with cross break and double sloping pitch to drain connection. Provide drain pans under cooling coil section. Drain connection centerline shall be above the base rail to aid in proper condensate trapping. There must be a full 2” thickness of insulation under drain pan.

2.4 FAN ASSEMBLIES

A. Acceptable fan assembly shall be a double width, double inlet, class II, belt-drive type housed airfoil fan dynamically balanced as an assembly. Maximum fan RPM shall be below first critical fan speed. Fan assemblies shall be dynamically balanced by the manufacturer on all three planes and at all bearing supports. Copper lubrication lines shall be provided and extend from the bearings and attached with grease fittings to the fan base assembly near access door. Provide access to motor, drive, and bearings through hinged access door.

B. Fan and motor shall be mounted internally on a steel base. Factory mount motor on slide base that can be slid out the side of the unit if removal is required. Fan and motor assembly shall be mounted on 2" deflection spring type vibration isolators inside cabinetry.

2.5 BEARINGS, SHAFTS, AND DRIVES

A. Bearings: Basic load rating computed in accordance with AFBMA - ANSI Standards. The bearings shall be designed for service with an L-50 life of 200,000 hours and shall be a heavy duty pillow block, self-aligning, grease-lubricated ball or spherical roller bearing type.

B. Shafts shall be solid, hot rolled steel, ground and polished, keyed to shaft, and protectively coated with lubricating oil. Hollow shafts are not acceptable.

C. V-Belt drives shall be cast iron or steel sheaves, dynamically balanced, bored and keyed to fit shafts. Fixed sheaves, matched belts, and drive shall be rated based on motor horsepower. Minimum of 2 belts shall be provided on all fans with 10 HP motors and above. Standard drive service factor shall be minimum of 1.3 calculated based on fan brake horsepower.

2.6 ELECTRICAL

A. Fan motors shall be manufacturer provided and installed, Open Drip Proof, premium efficiency 1750 RPM, single speed, inverter duty. Complete electrical characteristics for each fan motor shall be as shown in schedule.
B. The air handler(s) shall be ETL listed. Units shall conform to bi-national standard ANSI/UL Standard 1995/CSA Standard C22.2 No. 236.

C. Wiring Termination: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclosed terminal lugs in terminal box shall be sized to NFPA 70.

D. Variable-Frequency Motor Controller: Comply with Section 262923 "Variable-Frequency Motor Controllers."

2.7 COOLING AND HEATING COILS

A. Certification: Acceptable water cooling and water heating, coils shall be certified in accordance with AHRI Standard 410 and bear the AHRI label. Coils exceeding the scope of the manufacturer’s certification and/or the range of AHRI’s standard rating conditions will be considered provided the manufacturer is a current member of the AHRI Forced Circulation Air-Cooling and Air-Heating Coils certification programs and that the coils have been rated in accordance with AHRI Standard 410. Manufacturer must be ISO 9002 certified.

B. Water cooling coil shall be provided. Provide access to coil(s) for service and cleaning. Enclose coil headers and return bends fully within unit casing. Unit shall be provided with coil connections that extend a minimum of 5” beyond unit casing for ease of installation. Drain and vent connections shall be provided exterior to unit casing. Coil connections must be factory sealed with grommets on interior and exterior panel liners to minimize air leakage and condensation inside panel assembly. Coils shall be removable through side panels of unit without the need to remove and disassemble the entire section from the unit.

1. Headers shall consist of seamless copper tubing. Headers shall have intruded tube holes. Header diameter shall be determined by manufacturer based on fluid flow requirements.
2. Fins shall have a minimum thickness of 0.0075 inch aluminum plate construction. Fins shall have full drawn collars to provide a continuous surface cover over the entire tube for maximum heat transfer. Tubes shall be mechanically expanded into the fins to provide a continuous primary to secondary compression bond over the entire finned length for maximum heat transfer rates. Bare copper tubes shall not be visible between fins.
3. Coil tubes shall be 5/8 inch OD seamless copper, 0.020 inch nominal tube wall thickness, expanded into fins, brazed at joints.
4. Coil connections shall be carbon steel, NPT threaded connection. Connection size to be determined by manufacturer.
5. Coil casing shall be a formed channel frame of galvanized steel.

C. Water heating coil shall be provided. Provide access to coil(s) for service and cleaning. Enclose coil headers and return bends fully within unit casing. Unit shall be provided with coil connections that extend a minimum of 5” beyond unit casing for ease of installation. Drain and vent connections shall be provided exterior to unit casing. Coil connections must be factory sealed with grommets on interior and exterior panel liners to minimize air leakage and condensation inside panel assembly. Coils shall be removable through side panels of unit without the need to remove and disassemble the entire section from the unit.

1. Headers shall consist of seamless copper tubing. Headers to have intruded tube holes. Header diameter shall be determined by manufacturer based on fluid flow requirements.
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3. Coil tubes shall be 5/8 inch OD seamless copper, 0.020 inch nominal tube wall thickness, expanded into fins, brazed at joints.

4. Coil connections shall be carbon steel, threaded connection. Connection size to be determined by manufacturer.

5. Coil shall be furnished as an uncase galvanized steel to allow for thermal movement and slide into a pitched track for fluid drainage.

2.8 FILTERS

A. Furnish combination filter section with 2-inch pleated MERV 8 flat pre-filter and 12-inch Varicel SH cartridge 85% efficient (MERV 14) final filter. Provide side loading and removal of filters.

B. Filter media shall be UL 900 listed, Class I or Class II.

C. Provide field-mounted magnetic pressure gauges for prefilter and final filter, mounted on exterior of AHU casing. Seal all fastener penetrations to prevent air leakage.

2.9 ADDITIONAL SECTIONS

A. Provide 1 20-inch access section between filters and preheat coil, and between preheat and cooling coils.

2.10 DAMPERS

A. Dampers: Comply with requirements in Section 230923.12 "Control Dampers."

B. Outdoor- and Return-Air Dampers: Low-leakage, double-skin, airfoil-blade, [galvanized-steel] [Insert material] dampers with compressible jamb seals and extruded-vinyl blade edge seals in [opposed] [parallel]-blade arrangement with [zinc-plated] steel operating rods rotating in [sintered bronze or nylon] [Insert material] bearings mounted in a single [galvanized-steel] [Insert material] frame, and with operating rods connected with a common linkage. Leakage rate shall not exceed 4 cfm/sq. ft. at 1-inch wg and 8 cfm/sq. ft. at 4-inch wg.

C. Damper Operators: Comply with requirements in Section 230923.12 "Control Dampers."

D. Electronic Damper Operators:

1. Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.

2. Electronic damper position indicator shall have visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.

3. Operator Motors:
a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

b. Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.

c. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.

4. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.

5. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running and breakaway torque of 150 in. x lbf.

6. Size dampers for running torque calculated as follows:

   b. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. of damper.
   c. Parallel-Blade Damper without Edge Seals: 4 inch-lb/sq. ft. of damper.
   d. Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. of damper.
   e. Dampers with 2- to 3-Inch wg of Pressure Drop or Face Velocities of 1000 to 2500 fpm: Increase running torque by 1.5.
   f. Dampers with 3- to 4-Inch wg of Pressure Drop or Face Velocities of 2500 to 3000 fpm: Increase running torque by 2.0.


8. Overload Protection: Electronic overload or digital rotation-sensing circuitry.


10. Power Requirements (Two-Position Spring Return): [24 V dc] [120 V ac] [230 V ac].

11. Power Requirements (Modulating): Maximum 10 VA at 24 V ac or 8 W at 24 V dc.

12. Proportional Signal: 2 to 10 V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.

13. Temperature Rating: [Minus 22 to plus 122 deg F] [40 to 104 deg F].

14. Run Time: [12 seconds open, 5 seconds closed] [30 seconds] [60 seconds] [120 seconds].

E. Mixing Section: Multiple-blade, air-mixer assembly located immediately downstream of mixing section.

F. Combination Filter and Mixing Section:

   1. Cabinet support members shall hold [2-inch-] <Insert dimension> thick, pleated, flat, permanent or throwaway filters.

2.11 SOURCE QUALITY CONTROL

A. AHRI 430 Certification: Air-handling units and their components shall be factory tested according to AHRI 430 and shall be listed and labeled by AHRI.
B. AMCA 300 and AMCA 301, or AHRI 260 Certification: Air-handling unit fan sound ratings shall comply with AMCA 300, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data" and AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data," or with AHRI 260, "Sound Rating of Ducted Air Moving and Conditioning Equipment."

C. Water Coils: Factory tested to 300 psig according to AHRI 410 and ASHRAE 33.

D. Refrigerant Coils: Factory tested to minimum 450-psig internal pressure, and to minimum 300-psig internal pressure while underwater, according to AHRI 410 and ASHRAE 33.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Examine roughing-in for hydronic, and condensate drainage piping systems and electrical services to verify actual locations of connections before installation.

B. Equipment Mounting:

1. Install air-handling units on cast-in-place concrete equipment bases. Coordinate sizes and locations of concrete bases with actual equipment provided. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."

C. Arrange installation of units to provide access space around air-handling units for service and maintenance.

D. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing with new, clean filters.

E. Connect duct to air-handling units with flexible connections. Comply with requirements in Section 233300 "Air Duct Accessories."

3.2 PIPING CONNECTIONS

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

B. Where installing piping adjacent to air-handling unit, allow for service and maintenance.

C. Condensate Drain, Hot- and Chilled-Water Piping: Comply with applicable requirements in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties." Install shutoff valve and union or flange at each coil supply connection. Install balancing valve and union or flange at each coil return connection.
3.3 ELECTRICAL CONNECTIONS
   A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
   B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
   C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.
   D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
      1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."

3.4 CONTROL CONNECTIONS
   A. Install control and electrical power wiring to field-mounted control devices.
   B. Connect control wiring according to Section 260523 "Control-Voltage Electrical Power Cables."

3.5 FIELD QUALITY CONTROL
   A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
   B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
      1. Leak Test: After installation, fill water and steam coils with water, and test coils and connections for leaks.
      2. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   C. Air-handling unit and components will be considered defective if unit or components do not pass tests and inspections.
   D. Prepare test and inspection reports.

3.6 DEMONSTRATION
   A. Train Owner's maintenance personnel to adjust, operate, and maintain air-handling units.

END OF SECTION 237313.13
SECTION 238213 - RADIANT HEATING PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Hydronic heating panels.

1.2 ACTION SUBMITTALS

A. Product Data: Include rated capacities, specialties, and accessories for each product indicated.

B. Shop Drawings:
   1. Include plans, elevations, sections, details, and attachments to other work. Detail equipment assemblies and suspension and attachment.
   2. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Include diagrams for power, signal, and control wiring.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 HYDRONIC HEATING PANELS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   1. Armstrong Ceiling Solutions.
   2. Rittling

B. Description: Linear sheet-metal panel with serpentine water piping, suitable for lay-in installation flush with T-bar ceiling grid.
   1. Panels: Minimum 0.0396-inch- thick, aluminum sheet.
   2. Backing Insulation: Minimum 1-inch- thick, mineral or glass fibers bonded with a thermosetting resin.
4. Factory Piping: Minimum 0.504 -in. ID copper tube mechanically attached to panel.
5. Provide non-hardening heat conductive paste between copper tubing and aluminum panel.
6. All interconnecting of radiant panels shall consist of 3/8in. nominal, 0.5in. O.D. soft copper tubing or manufacturer recommended accessories, i.e. factory supplied 360-degree inter-connecting loops and 180 degree return U-bends. Supply first to panel tubing pass closest to perimeter wall. Multiple panels shall be circuited to ensure serpentine flow over complete length of zone. Individual serpentine panel coils connected in series is unacceptable for multiple panel zones.
7. Accessories:
   a. 5-inch (127-mm) male bullnose panel.
   b. 5-inch female bullnose panel.
   c. 1/2-inch filler panel.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install radiant heating panels level and plumb.

B. Suspend radiant panels from structure.

C. Coordinate layout and installation of radiant panels and suspension-system components with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, communications system, security system, and partition assemblies.

D. Support for Radiant Heating Panels in or on Grid-Type Suspended Ceilings: Use grid as a support element.
   1. Install a minimum of four ceiling support-system rods or wires for each panel. Locate not more than 6 inches from panel corners.
   2. Support Clips: Fasten to panel and to ceiling grid members at or near each panel corner with clips designed for the application.

E. All radiant panels shall run continuous from wall-to-wall and shall be field trimmed to length ensuring adequate expansion allowance while maintaining panel end coverage by architectural moldings. Inactive filler panels will be permitted only where indicated on drawings.

F. Piping installation requirements are specified in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties. Drawings indicate general arrangement of piping, fittings, and specialties.

G. Unless otherwise indicated, install shutoff valve and union or flange at each connection.

H. Install piping adjacent to unit to allow service and maintenance.
I. All system piping shall be thoroughly cleaned, flushed, drained and refilled before radiant panels are connected into the system.

J. Each group or zone of coils shall be given a pressure test in accordance with procedures specified in Section 232113 “Hydronic Piping”.

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and units.

B. Remove and replace malfunctioning units and retest as specified above.

C. After installing panels, inspect unit cabinet for damage to finish. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

D. Prepare test and inspection reports.

END OF SECTION 238213
SECTION 238239 - CABINET UNIT HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division Specification Sections, as applicable, shall apply to this section.

1.2 SUMMARY

A. Section Includes:
   1. Cabinet unit heaters

B. The work under this Section of the Specification shall include the furnishing of labor, materials and equipment for the installation of complete system to provide continuous and satisfactory service.

1.3 ACTION SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each product indicated. Include specialties and accessories for each unit type and configuration.

1.4 INFORMATIONAL SUBMITTALS

A. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection. Submit the following for each unit type and configuration:

   1. Plans, elevations, sections, and details.
   2. Location and size of each field connection.
   3. Details of anchorages and attachments to structure and to supported equipment.
   5. Equipment schedules to include rated capacities; operating characteristics, shipping, installed, and operating weights; furnished specialties, and accessories.

B. Samples for Initial Selection: Manufacturer’s color charts showing the full range of Finish colors available for units with factory-applied color finishes.

C. Samples for Verification: Finish colors for each type of unit heater and wall and ceiling heaters indicated with factory-applied color finishes.

D. Field quality-control test reports: Written reports of tests specified in Part 3 of this Section.
E. Operation and Maintenance Data: For cabinet unit heaters to include in emergency, operation, and maintenance manuals specified in Division 1. Include the following:

1. Maintenance schedules and repair parts lists for motors, coils, integral controls, and filters.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."


1.6 COORDINATION

A. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Suspended ceiling components.
2. Structural members to which unit heaters will be attached.
3. Method of attaching hangers to building structure.
4. Size and location of initial access modules for acoustical tile.
5. Items penetrating finished ceiling, including but not limited to the following:
   a. Lighting fixtures.
   b. Air outlets and inlets.
   c. Speakers.
   d. Sprinklers.
   e. Access panels.

PART 2 - PRODUCTS

2.1 CABINET UNIT HEATER-CEILING MOUNTED

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Rittling
2. Sterling
3. Trane
4. Vulcan Radiator

B. Cabinet
1. The cabinet shall be 18 gauge steel with 18 gauge cold rolled steel side and top panels. Front panel shall be 16 gauge cold rolled steel. All painted surfaces shall be treated for corrosion resistance prior to being finished with a baked on polyester powder coat finish. All unpainted steel shall be galvanized. Unit will have 1/2" (1-1/2 pound per cubic foot) insulation.

2. Cabinets shall have stamped louvers. The entire bottom of the unit shall be enclosed. Access to the speed control shall be through the 16 gauge front access panels.

3. Unit shall have hinged front panel. The multiple hinges shall provide full swing through 90 Degrees. A safety chain shall be provided to prevent the face panel from swinging fully open accidentally. The chain must be easily detached to allow full access for servicing.

C. Coils

1. Heating coils shall be mechanically bonded copper/aluminum. Heating coils shall be tested at factory at 250 PSI and rated at a 300 psi working pressure.

D. Motor Speed Control

1. Unit shall have a unit mounted solid state motor speed control, with high through low speeds and off positions.

E. Motors, Blowers and Drives

1. Blowers shall be centrifugal, forward curved, double width of electro galvanneal steel. Fan housing shall be formed galvanized sheet metal. Units shall have PSC motors and integral thermal protection. The motor and blower assembly shall be capable of being easily removed from the unit. Motors are built for continuous duty to NEMA standards.

F. Filters

1. Return shall be filtered by a cleanable expanded aluminum filter. Filters shall be slide in type with are locked into position. Provide two sets of filters to Towson University for stock.

G. Mounting Brackets

1. Cabinets shall have adjustable mounting brackets.

H. Provide motor starter, disconnect switch and tamper proof screws.

I. Install per manufacturer’s requirements.

2.2 CABINET UNIT HEATER-FLOOR MOUNTED

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Rittling
2. Sterling
3. Trane
4. Vulcan Radiator

B. Cabinet
1. The cabinet shall be 18 gauge steel with 18 gauge cold rolled steel side and top panels. Front panel shall be 16 gauge cold rolled steel. All painted surfaces shall be treated for corrosion resistance prior to being finished with a baked on polyester powder coat finish. All unpainted steel shall be galvanized. Unit will have 1/2” (1-1/2 pound per cubic foot) insulation.
2. Cabinets shall have stamped louvers. The entire bottom of the unit shall be enclosed. Access to the speed control shall be through the 16 gauge front access panels.
3. Unit shall have two 9” wide minimum piping end pockets and hinged access panels.

C. Coils
1. Heating coils shall be mechanically bonded copper/aluminum. Heating coils shall be tested at factory at 250 PSI and rated at a 300 psi working pressure.

D. Motor Speed Control
1. Unit shall have a unit mounted solid state motor speed control, with high through low speeds and off positions.

E. Motors, Blowers and Drives
1. Blowers shall be centrifugal, forward curved, double width of electro galvanneal steel. Fan housing shall be formed galvanized sheet metal. Units shall have PSC motors and integral thermal protection. The motor and blower assembly shall be capable of being easily removed from the unit. Motors are built for continuous duty to NEMA standards.

F. Filters
1. Return shall be filtered by a cleanable expanded aluminum filter. Filters shall be slide in type with are locked into position. Provide two sets of filters to Towson University for stock.

G. Mounting Brackets
1. Cabinets shall have adjustable mounting brackets.
2. Provide leveling legs.

H. Provide motor starter, disconnect switch and tamper proof screws.
I. Install per manufacturer’s requirements.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Examine areas to receive unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in for electrical connections to verify actual locations before unit heater installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.
3.2 INSTALLATION
   A. Maintain manufacturers' recommended clearances.
   B. Install per manufacturer’s requirements.
   C. Install wall-mounting thermostats and switch controls in electrical outlet boxes at heights to match lighting controls.

3.3 CONNECTIONS
   A. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
   B. Tighten electrical connectors and terminals according to manufacturer’s published torque-tightening values. If manufacturer’s torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL
   A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
   B. Testing: Perform the following field quality-control testing and report results in writing:
      1. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
      2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
      3. Test and adjust controls and safeties.
   C. Repair or replace malfunctioning units. Retest as specified above after repairs or replacements are made.

3.5 CLEANING
   A. After installing units, inspect unit cabinet for damage to finish. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

3.6 ADJUSTING
   A. Adjust initial temperature set points.

END OF SECTION 238239
SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 CODES, LAWS AND ORDINANCES

A. Work shall conform to the applicable codes, laws, ordinances and regulations for the Project’s location.

B. The requirements of the Authorities Having Jurisdiction (AHJ) shall take precedence over the Drawings and these Specifications. Changes required by the AHJ shall only be made after review by the Engineer.

1.3 DEFINITIONS

A. Wiring: Includes conductors, raceways, cables, fixing, boxes and other accessories that comprise of a complete system.

B. Provide: To furnish and install complete.

1.4 SUBMITTALS

A. Review and approval of shop drawings does not relieve the contractor of responsibility for complying with the Contract Documents or coordination with other disciplines.

1.5 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.

2. To provide for ease of disconnecting the equipment with minimum interference to other installations.

3. To allow right of way for piping installed at required slope.

4. So connecting raceways, cables, etc. will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set structural components as they are constructed.
C. In general, boxes, devices and equipment shall be accessible through the removable panels in the ceiling. Where ceilings are not removable and in walls where access is required for service, access panels shall be provided. Access panels shall be appropriate for the finish in which they are installed, with a fire rating to match the wall or ceiling in which they are installed. Coordinate with other Divisions and group boxes, devices and equipment together to keep the required number of access panels to a minimum.

1.6 PROJECT CONDITIONS

A. Contractor shall visit the site and become familiar with the existing conditions. Modifications to work required to allow for existing conditions shall be provided. Submit proposed modifications to the Engineer for approval prior to installation.

B. Interruption of Existing Electric Services and Systems: Do not interrupt electric services or systems to and within the facility unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Owner no fewer than seven days in advance of proposed interruption.
2. Indicate method of providing temporary service or operation.
3. Do not proceed with interruptions without Owner's written permission.

1.7 DEMOLITION AND ALTERATIONS

A. Where electrical systems pass through the renovated areas to serve other portions of the premises, they shall be suitably relocated and the systems restored to normal operation. Any outages in systems shall be coordinated with the appropriate personnel. Where durations of proposed outages cannot be tolerated, provide temporary connections as required to maintain services.

B. Relocate existing hangers, supports, etc where necessary to install new work. Maximum spacing requirements of the NEC apply to relocated supports.

C. Where new devices are added to existing walls and ceilings, associated wiring shall be installed concealed. Chase existing walls as required. Devices and associated boxes shall be installed flush.

D. Where new finishes or treatments are added to existing walls and ceilings, provide necessary outlet box extensions, plaster rinks, etc., so that existing devices remain in the same manner (IE flush, concealed, surface)

E. Equipment removed that is salvageable and desired by its Owner to be retained, shall be stored on the project site where directed by the Owner. Otherwise, materials and equipment removed shall become the property of the Contractor and shall be removed by him/her from the premises and shall be disposed of properly in accordance local, state and federal regulations.

F. In each area to be renovated, remove the entire existing electrical installation except those portions indicated to be reused. When existing electrical work is removed, remove raceways, supports, etc. to a point far enough behind surface to allow for the installation of the normal
thickness of finished material. Unused wiring and cable shall be disconnected and removed back to their source.

G. When the new work connects to existing equipment, conduit, wiring, etc., perform necessary alterations, cuttings, fitting, etc. of the existing work as may be necessary or required to make satisfactory connections between the new and existing work and leave the complete work in a finished and workmanlike condition.

1.8 PROTECTION
A. Protect materials and equipment from damage.
B. Cap or plug openings in equipment and conduits.

1.9 VARIANCES
A. Where conflicts exist within the contract documents, request clarification prior to submission of bid. If clarification is not requested, provide the work representing the higher cost and quantity.

1.10 WARRANTY
A. During the warranty period, make the proper adjustments to systems, equipment and devices installed and perform work necessary to ensure the efficient and proper functioning of the systems, equipment or devices.

1.11 TEMPORARY POWER AND LIGHTING
A. Services, devices, equipment, fixtures, wiring, etc required for temporary power and lighting are not covered under the Division.

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES
A. Steel Pipe Sleeves: Schedule 40, galvanized steel, plain ends.

2.2 GROUT
A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.
PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Items shown and not specifically called for, or items specified and not specifically indicated or detailed on the Drawings, or items neither specified nor shown, but which are reasonably incidental to and commonly required to make a complete job, shall be provided.

B. Provide foundations, supports and bases for equipment as indicated or necessary for satisfactory installation and operation of equipment, including the furnishing and setting of anchor hardware.

C. Measure indicated mounting heights to bottom of suspended items and to center of wall-mounting items unless otherwise noted.

D. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

E. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

F. Right of Way: Give to piping systems installed at a required slope.

3.2 FIRESTOPPING

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly.

END OF SECTION 260500
SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

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

1.2 SUMMARY
   A. This Section includes the following:
      1. Building wires and cables rated 600 V and less.
      2. Connectors, splices, and terminations rated 600 V and less.

1.3 QUALITY ASSURANCE
   A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
   B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES
   A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1. Alcan Products Corporation; Alcan Cable Division.
      3. General Cable Corporation.
      4. Senator Wire & Cable Company.
      5. Southwire Company.
      6. or approved equal
   B. Copper Conductors: Comply with NEMA WC 70.
   C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN.
2.2 CONNECTORS AND SPLICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems, Inc.
3. O-Z/Gedney; EGS Electrical Group LLC.
4. 3M; Electrical Products Division.
5. Tyco Electronics Corp.
6. or approved equal

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND WIRING METHODS

A. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlsaces: Type THHN-THWN, single conductors in raceway unless otherwise noted.

B. Exposed Branch Circuits and Feeders, Including in Crawlsaces: Type THHN-THWN, single conductors in raceway, unless otherwise noted.

C. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN single conductors in raceway, unless otherwise noted.

3.3 INSTALLATION OF CONDUCTORS

A. Conceal circuits and/or feeders in finished walls, ceilings, and floors, unless otherwise indicated.

B. Use manufacturer approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
D. Exposed circuits and/or feeders shall be installed parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."

F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

   1. When the use of aluminum conductors is permitted, use oxide inhibitor in each splice and tap conductor.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.5 FIELD QUALITY CONTROL

A. Tests and Inspections:

   1. After installing conductors and before electrical circuitry has been energized, test for compliance with requirements.


B. Correct deficiencies and retest as specified above.

END OF SECTION 260519
SECTION 260523 - CONTROL-VOLTAGE ELECTRICAL POWER CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. UTP cabling.
2. Low-voltage control cabling.
3. Control-circuit conductors.
4. Identification products.

1.3 DEFINITIONS

A. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.

B. UTP: Unshielded twisted pair.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Install in accordance with NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

PART 2 - PRODUCTS

A. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems."

1. Outlet boxes shall be no smaller than 4 inches wide, 4 inches high, and 2-1/2 inches deep with appropriate raised covers as applicable to suite the installation conditions.
2.2 UTP CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by:
   1. Belden CDT Inc.; Electronics Division.
   2. Mohawk; a division of Belden CDT.
   3. Superior Essex Inc.
   4. Or equal.

B. Description: four-pair UTP.
   1. Comply with ICEA S-90-661 for mechanical properties.
   2. Comply with TIA/EIA-568-B.1 for performance specifications.
   4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
      a. Communications, Plenum Rated: Type CMP, complying with NFPA 262.

2.3 LOW-VOLTAGE CONTROL CABLE

A. Paired Cable: NFPA 70, Type CMG.
   1. One pair, twisted, No. 16 AWG, stranded (19x29) tinned-copper conductors.
   2. PVC insulation.
   3. Unshielded.
   4. PVC jacket.
   5. Flame Resistance: Comply with UL 1581.

2.4 CONTROL-CIRCUIT CONDUCTORS

A. Class 1 Control Circuits: Stranded copper, Type THHN-THWN in raceway.

B. Class 2 Control Circuits: Stranded copper, Type THHN-THWN, in raceway.

C. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type TW or Type TF, complying with UL 83, in raceway.

2.5 IDENTIFICATION PRODUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Brady Corporation.
   2. HellermannTyton.
   3. Kroy LLC.
   4. Panduit Corp.
   5. or approved equal.
B. Comply with UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

C. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

2.6 SOURCE QUALITY CONTROL

A. Factory test UTP cables according to TIA/EIA-568-B.2.

B. Cable will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

EXECUTION

2.7 INSTALLATION OF PATHWAYS

A. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.

B. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.

C. Install manufactured conduit sweeps and long-radius elbows if possible.

2.8 INSTALLATION OF CONDUCTORS AND CABLES

A. General Requirements for Cabling:
   2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
   3. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at terminals.
   4. Cables may not be spliced.
   5. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
   6. Do not install bruised, kinked, scored, deformed, or abraded cable. Remove and discard cable if damaged during installation and replace it with new cable.
   7. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
   8. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

B. UTP Cable Installation:

C. Installation of Control-Circuit Conductors:
1. Install wiring in raceways. Comply with requirements specified in Division 26 Section "Raceway and Boxes for Electrical Systems."

D. Separation from EMI Sources:
   1. Comply with BICSI TDMM and TIA/EIA-569-A recommendations for separating unshielded copper data communication cable from potential EMI sources, including electrical power lines and equipment.
   2. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
      b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
   3. Separation between Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
   4. Separation between Cables and Light Fixtures: A minimum of 5 inches.

2.9 REMOVAL OF CONDUCTORS AND CABLES
   A. Remove abandoned conductors and cables.

2.10 CONTROL-CIRCUIT CONDUCTORS
   A. Minimum Conductor Sizes:
      1. Unless otherwise indicated, Class 1 remote-control and signal circuits, No 14 AWG minimum.
      2. Unless otherwise indicated, Class 2 low-energy, remote-control, and signal circuits, No. 16 AWG minimum.
      3. Unless otherwise indicated, Class 3 low-energy, remote-control, alarm, and signal circuits, No 12 AWG minimum.

2.11 GROUNDING
   A. For low-voltage wiring and cabling, comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems."

2.12 IDENTIFICATION
   A. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

2.13 FIELD QUALITY CONTROL
   A. Perform tests and inspections.
B. Tests and Inspections:
   1. Visually inspect UTP cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA/EIA-568-B.1.
   2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
   3. Test UTP cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not after cross connection.
      a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
   C. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.
   D. End-to-end cabling will be considered defective if it does not pass tests and inspections.
   E. Prepare test and inspection reports.

END OF SECTION 260523
SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

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

1.2 SUMMARY
   A. This Section includes methods and materials for grounding systems and equipment.

1.3 SUBMITTALS
   A. Shop Drawings: For each type of product indicated.

PART 2 - PRODUCTS

2.1 CONDUCTORS
   A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

2.2 CONNECTORS
   A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.
   B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
      1. Pipe Connectors: Clamp type, sized for pipe.

PART 3 - EXECUTION

3.1 APPLICATIONS
   A. Conductors: Install solid conductor for No. 10 AWG and smaller, and stranded conductors for No. 8 AWG and larger, unless otherwise indicated.
B. Conductor Terminations and Connections:
   1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.

3.2 EQUIPMENT GROUNDING
   A. Install insulated equipment grounding conductors with all feeders and branch circuits.

3.3 INSTALLATION
   A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

3.4 FIELD QUALITY CONTROL
   A. Perform the following tests and inspections
      1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
   B. Report measured ground resistances that exceed the following values:
      1. Power and Lighting Equipment or Systems: 5 ohms.
   C. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect/Engineer promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526
SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

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

1.2 SUMMARY
   A. This Section includes the following:
       1. Hangers and supports for electrical equipment and systems.

1.3 DEFINITIONS
   A. EMT: Electrical metallic tubing.

1.4 PERFORMANCE REQUIREMENTS
   A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
   B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
   C. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.5 QUALITY ASSURANCE
   A. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS
   A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Allied Tube & Conduit.
   b. Cooper B-Line, Inc.; a division of Cooper Industries.
   c. Thomas & Betts Corporation.
   d. Unistrut; Tyco International, Ltd.
   e. Or equal.

2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.

3. Channel Dimensions: Selected for applicable load criteria.

B. Conduit Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway to be supported.

C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

D. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Cooper B-Line, Inc.; a division of Cooper Industries.
      2) Empire Tool and Manufacturing Co., Inc.
      3) Hilti Inc.
      4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      5) MKT Fastening, LLC.
      6) Or equal.

2. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.

3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.

4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.

5. Toggle Bolts: All-steel springhead type.

PART 3 - EXECUTION

3.1 APPLICATION

A. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for conduits as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

B. Multiple Raceways: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with two-bolt conduit clamps.

C. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Raceway Support Methods: In addition to methods described in NECA 1, conduits may be supported by openings through structure members, as permitted in NFPA 70.

B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
3. To Existing Concrete: Expansion anchor fasteners.
4. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
5. To Light Steel: Sheet metal screws.
6. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.

3.3 PAINTING

A. Galvanized Surfaces: Clean bolted connections and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.
END OF SECTION 260529
SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

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

1.2 SUMMARY
   A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1.3 DEFINITIONS
   A. EMT: Electrical metallic tubing.
   B. FMC: Flexible metal conduit.

1.4 QUALITY ASSURANCE
   A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
   B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING
   A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1. AFC Cable Systems, Inc.
      2. Alflex Inc.
      3. Allied Tube & Conduit; a Tyco International Ltd. Co.
      4. Anamet Electrical, Inc.; Anaconda Metal Hose.
      5. Electri-Flex Co.
      7. Maverick Tube Corporation.
10. Or equal.

C. Rigid Steel Conduit: ANSI C80.1.

D. EMT: ANSI C80.3.

E. FMC: Zinc-coated steel.

F. Fittings for Conduit: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
   1. Fittings for EMT: Steel or die-cast, compression type.

2.2 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
   2. Hoffman.
   4. O-Z/Gedney; a unit of General Signal.
   5. RACO; a Hubbell Company.
   7. Or equal.

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

C. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Comply with the following indoor applications, unless otherwise indicated:
   1. Exposed: EMT.
   2. Concealed in Ceilings and Interior Walls and Partitions: EMT.
   3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC.

B. Minimum Raceway Size: 3/4-inch trade size.

C. Raceway Fittings: Compatible with raceways and suitable for use and location.
D. Do not install aluminum conduit.

3.2 INSTALLATION

A. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

B. Complete raceway installation before starting conductor installation.

C. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."

D. Conceal conduit within finished walls and ceilings, unless otherwise indicated or required by connection to surface mounted equipment.

E. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.

F. Flexible Conduit Connections: Use maximum of 72 inches of flexible conduit for light fixtures or equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

3.3 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and materials are without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Identification for raceways.
   2. Identification of control cables.
   3. Identification for conductors.
   4. Equipment identification labels.

1.3 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.4 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and with those required by codes and standards. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.
PART 2 - PRODUCTS

2.1 POWER RACEWAY IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.

B. Colors for Raceways Carrying Circuits at 600 V or Less:
   1. Black letters on an orange field.
   2. Legend: Indicate voltage and circuit/feeder identifications.

C. Self-Adhesive Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

2.2 CONTROL CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

2.3 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

C. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.4 EQUIPMENT IDENTIFICATION LABELS

PART 3 - EXECUTION

3.1 INSTALLATION
   A. Verify identity of each item before fabricating and installing identification products.

   B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

   C. Apply identification devices to surfaces that require finish after completing finish work.

   D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

   E. System Identification Color-Coding Bands for Raceways: Each color-coding band shall completely encircle conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

3.2 IDENTIFICATION SCHEDULE
   A. Accessible Raceways, 600 V or Less, for Service, Feeder, and Branch Circuits 15 amperes or greater and 100V to ground: Identify with self-adhesive vinyl label. Install labels at 30-foot maximum intervals.

   B. Power-Circuit Conductor Identification, 600 V or Less: For conductors in pull and junction boxes, use color-coding conductor tape to identify the phase.

      1. Color-Coding for Phase Identification, 600 V or Less: Use colors listed below for service, feeder and branch-circuit conductors.

         a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.

         b. Colors for 208/120-V Circuits:

            1) Phase A: Black.
            2) Phase B: Red.
            3) Phase C: Blue.

         c. Colors for 480/277-V Circuits:

            1) Phase A: Brown.
            2) Phase B: Orange.
            3) Phase C: Yellow.

         d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
C. Equipment Identification Labels: On each unit of equipment, install a unique designation label that is consistent with the designations on plan.

1. Labeling Instructions:
   a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic label. Unless otherwise indicated, provide a single line of text with 1/2-inch high letters on 1-1/2-inch high label; where two lines of text are required, use labels 2 inches high.

2. Equipment to Be Labeled:
   a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be self-adhesive, engraved, laminated acrylic or melamine label.
   b. Enclosed switches.
   c. Enclosed controllers.
   d. All wiring devices: On inside of cover plates, identify branch circuit number and panelboards that devices are fed from. Identify with self-adhesive vinyl label.

END OF SECTION 260553
SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
   B. It shall be the responsibility of the contractor to furnish and install all devices, components and wiring as needed in accordance with the recommendations of the manufacturer and the applicable requirements of the National Electrical Code.

1.2 SUMMARY
   A. This Section includes lighting control devices and systems.
   B. Related Sections include the following:
      1. Division 26 Section "Wiring Devices" for line voltage wall-switch vacancy sensors and manual light switches.
      2. Division 26 Section "Wiring Devices" for standalone ceiling mounted vacancy sensors and associated power/relay packs.

1.3 SUBMITTALS
   A. Shop Drawings: For each type of lighting control device and system:
      1. In addition to the information related to the specific devices, shop drawing to include scaled plans showing locations of all devices and the interconnecting wiring requirements.
   B. Operation and Maintenance Data: Each lighting control device and system shall be included in the operation and maintenance manuals.

1.4 QUALITY ASSURANCE
   A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
1.5 COORDINATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 LIGHTING CONTROL DEVICES AND SYSTEMS

A. Unless otherwise indicated, all lighting control system devices and system components shall be the product of a single manufacturer:

1. Lutron.
2. nlight.
3. Or approved equal.

B. Vacancy Sensors: Low voltage ceiling mounted dual technology type with standard 360 degree range. White housing.

C. Daylighting Sensors: Low voltage ceiling mounted dual technology type with standard 360 degree range and automatic dimming control photocell. White housing.

D. Load Controllers: 120/277 volt, 16 amp minimum rated power/relay packs for controlling lighting loads and 120 volt, 20 amp minimum rated power/relay packs for controlling plug loads. Plenum rate enclosures. Provide dimming, non-dimming and emergency load type controllers as required for the intended control of light fixtures.

E. User Interfaces: Low voltage, single channel wall mounted lighting control stations with associated faceplates. White housing and faceplates. Provide 2 button on-off stations or 3 button on/off/dimming where indicated on drawings.

2.2 CONDUCTORS AND CABLES

A. Power Wiring: Not smaller than No. 12 AWG.

B. Classes 2 and 3 Control Cable: Multiconductor cable with plenum rated jackets per requirements of device manufacturer.

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

A. Install vacancy sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.
B. Install daylighting sensors in accordance with manufacturer’s recommendations and applicable codes.

3.2 WIRING INSTALLATION
A. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be 3/4 inch.

3.3 IDENTIFICATION
A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL
A. Perform the following field tests and inspections and prepare test reports:
   1. After installing sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
   2. Operational Test: Verify operation of each lighting control device, and adjust time delays.

B. Lighting control devices that fail tests and inspections are defective work.

END OF SECTION 260923
SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Lighting and appliance branch-circuit panelboards.

1.3 SUBMITTALS

A. Shop Drawings: For each type of panelboard and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
2. Detail bus configuration, current, and voltage ratings.
4. Include evidence of NRTL listing for series rating of installed devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

B. Operation and Maintenance Data: The following products shall be included in the operation and maintenance manuals:

1. Panelboards.
2. Transient voltage suppression devices.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards.

1.6 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

1.8 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Keys: Two spares for each type of panelboard cabinet lock.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Enclosures: Flush or Surface-mounted cabinets as indicated on Drawings.

1. Rated for environmental conditions at installed location.

   a. Indoor Dry and Clean Locations: NEMA 250, Type 1.

2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions.

3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
4. Finishes:
   a. Panels and Trim: Galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
   b. Back Boxes: Galvanized steel, Same finish as panels and trim.


B. Incoming Mains Location: As required to suite installation.

C. Phase, Neutral, and Ground Buses:
   2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.

D. Conductor Connectors: Suitable for use with conductor material and sizes.
   2. Main and Neutral Lugs: Compression type.
   3. Ground Lugs and Bus-Configured Terminators: Compression type.

E. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

F. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include size and type of allowable upstream and branch devices, listed and labeled for series-connected short-circuit rating by an NRTL.

2.2 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   4. Square D; a brand of Schneider Electric.
   5. Or equal.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: As indicated on Drawings.

D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.3 PANELBOARD SUPPRESSORS

A. Manufacturers: Subject to compliance with requirements, provide products by the same manufacturer of panelboards.

B. Surge Protection Device: IEEE C62.41-compliant, integrally mounted, wired-in, solid-state, parallel-connected, non-modular type, with sine-wave tracking suppression and filtering modules, UL 1449, second edition, short-circuit current rating matching or exceeding the panelboard short-circuit rating, and with the following features and accessories:

1. Accessories:
   a. Fuses rated at 200-kA interrupting capacity.
   b. Fabrication using bolted compression lugs for internal wiring.
   c. Integral disconnect switch.
   d. Redundant suppression circuits.
   e. Redundant replaceable modules.
   f. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
   g. LED indicator lights for power and protection status.
   h. Audible alarm, with silencing switch, to indicate when protection has failed.
   i. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of system operation. Contacts shall reverse position on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
   j. Six-digit, transient-event counter set to totalize transient surges.


   a. Line to Neutral: 70,000A.
   b. Line to Ground: 70,000A.
   c. Neutral to Ground: 50,000A.

4. Withstand Capabilities: 12,000 IEEE C62.41, Category C3 (10 kA), 8-by-20-mic.sec. surges with less than 5 percent change in clamping voltage.

5. Protection modes and UL 1449 SVR for grounded wye circuits shall be as follows:
   a. Line to Neutral: 400 V for 208Y/120.
   b. Line to Ground: 400 V for 208Y/120.
   c. Neutral to Ground: 400 V for 208Y/120.

2.4 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.

B. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Mount top of trim 6’-6” above finished floor unless otherwise indicated.

B. Mount panelboard cabinet plumb and rigid without distortion of box.

C. Install filler plates in unused spaces.

D. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

3.3 IDENTIFICATION

A. Create a directory to indicate installed circuits. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

3.4 ADJUSTING

A. If applicable, set field-adjustable circuit-breaker trip ranges.

END OF SECTION 262416
SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Receptacles, receptacles with integral GFCI, and associated device plates.
   2. Snap switches (Toggle Switches).
   3. Line voltage wall vacancy sensors.
   4. Ceiling vacancy sensors with line power/relay packs.
   5. Wall-box dimmers
   6. Poke-through assemblies.

1.3 DEFINITIONS

A. GFCI: Ground-fault circuit interrupter.

B. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

1.4 SUBMITTALS

A. Shop Drawings: For each type of product indicated.

B. Operation and Maintenance Data: The following products shall be included in the operation and maintenance manuals:
   1. Occupancy sensors.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 STRAIGHT BLADE RECEPTACLES

A. Convenience Receptacles: 125 V. Duplex, double duplex or simplex as indicated on Drawings. 15A or 20 A to match amperage rating of connecting circuit. Comply with NEMA WD 1, NEMA WD 6 and UL 498.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   a. Cooper.
   b. Hubbell.
   c. Leviton.
   d. Pass & Seymour.
   e. Or equal.

2.2 GFCI RECEPTACLES

A. General Description: Straight blade, non-feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   a. Cooper.
   b. Pass & Seymour.
   c. Leviton.
   d. Hubbell.
   e. Or equal.

2.3 SNAP SWITCHES (TOGGLE SWITCHES)

A. Comply with NEMA WD 1 and UL 20.

B. Switches, 120/277 V. 15A or 20 A to match amperage rating of connecting circuit.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   a. Cooper.
   b. Hubbell.
c. Leviton.
d. Pass & Seymour.
e. Or equal.

2.4 LINE VOLTAGE VACANCY SENSORS

A. Long-Range Wall-Switch Sensors:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Lutron.
b. nlight.
c. Or approved equal.

2. Description: Dual technology, with both passive-infrared- and ultrasonic-type sensing, 120/277 V, adjustable time delay up to 30 minutes, 110-degree field of view, and a minimum coverage area of 1200 sq. ft. Each sensor is to be equipped with an integral dual output relay.

3. Operation: Manual depression of pushbutton turns lights/receptacles on and off. If lights are left on while room is unoccupied, lights/receptacles will turn off automatically one time delay setting period has occurred. Once lights have turned off automatically, depressing of button will turn lights/receptacles back on.

2.5 CEILING VACANCY SENSORS WITH LINE POWER/RELAY PACKS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Lutron
2. nlight.
3. Or approved equal.

B. General Description: Ceiling-mounting, solid-state units with a separate relay unit.

1. Operation: Unless otherwise indicated, allows lights to be turned on by local switching when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 30 minutes.

2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.

3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.

4. Mounting:

a. Sensor: Suitable for mounting in any position on a standard outlet box.
b. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
6. Bypass Switch: Override the on function in case of sensor failure.

C. Dual-Technology Type: Ceiling and wall mounting; detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on-off functions shall be selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6-inch minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
3. Detection Coverage (Standard Room): At a minimum, ceiling mounted units shall have the capability to detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch high ceiling.

2.6 WALL PLATES FOR POWER OUTLETS AND SWITCHES

A. Single and combination types to match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: Materials and finishes to match building standards.

2.7 POKE-THROUGH ASSEMBLIES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Hubbell.
2. Pass & Seymour.
3. Or equal.

B. Description: Factory-fabricated and -wired assembly of below-floor junction box with multi-channeled, through-floor raceway/firestop unit and detachable matching floor service outlet assembly.

1. Service Outlet Assembly: Flush type with outlet types and quantities as indicated on the Drawings.
2. Size: Selected to fit nominal 3-inch cored holes in floor and matched to floor thickness.
3. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
4. Closure Plug: Arranged to close unused cored openings and reestablish fire rating of floor.
5. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors and a minimum of four, 4-pair, Category 6 voice and data communication cables.
2.8 FINISHES

A. Color: Colors of wiring devices to match building’s standard.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Coordination with Other Trades:
   1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
   2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
   3. Install wiring devices after all wall preparation, including painting, is complete.

B. Conductors:
   1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
   2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
   3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.

C. Device Installation:
   1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
   2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
   3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
   4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
   5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
   6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
   7. Tighten unused terminal screws on the device.
   8. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

D. Receptacle Orientation:
   1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.
   2. 
E. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical. Group adjacent switches under single, multigang wall plates.

3.2 FIELD QUALITY CONTROL

A. Tests for Convenience Receptacles:
   1. Ground Impedance: Values of up to 2 ohms are acceptable.
   2. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
   3. Using the test plug, verify that the device and its outlet box are securely mounted.
   4. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

END OF SECTION 262726
SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Cartridge fuses rated 600-V ac and less for use in enclosed switches.

1.3 SUBMITTALS

A. Shop Drawing: For each type of product indicated.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA FU 1 for cartridge fuses.

D. Comply with NFPA 70.

1.5 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

1.6 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Bussmann, Inc.
2. Ferraz Shawmut, Inc.
3. Littelfuse, Inc.
4. Or equal.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

A. Cartridge Fuses:
   1. Other Branch Circuits: Class RK1, time delay.

3.3 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

END OF SECTION 262813
SECTION 262816 - ENCLOSED SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Fusible switches.
   2. Non-fusible switches.
   3. Enclosures.

1.3 SUBMITTALS

A. Shop Drawings: For each type of enclosed switch and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
   1. Enclosure types and details.
   2. Current and voltage ratings.
   3. Short-circuit current ratings (interrupting and withstand, as appropriate).
   4. Include evidence of NRTL listing for series rating of installed devices.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NFPA 70.

1.5 COORDINATION

A. Coordinate layout and installation of switches and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton.
2. General Electric.
3. Siemens.
4. Square D.
5. Or equal.

B. Type HD, Heavy Duty, Single Throw, 240 or 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate cartridge fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position. UL listed to accept both aluminum and copper conductors.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
4. Hookstick Handle: Allows use of a hookstick to operate the handle.
5. Lugs: Compression type, suitable for number, size, and conductor material.

2.2 NONFUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton.
2. General Electric.
3. Siemens.
4. Square D.
5. Or equal.

B. Type HD, Heavy Duty, Single Throw, 240 or 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position. UL listed to accept both aluminum and copper conductors.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Hookstick Handle: Allows use of a hookstick to operate the handle.
4. Lugs: Compression type, suitable for number, size, and conductor material.

2.3 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: To comply with environmental conditions at installed location.
   1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches for compliance with installation tolerances and other conditions affecting performance of the Work.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install individual wall-mounted switches with tops at uniform height unless otherwise indicated.
B. Install fuses in fusible devices.

3.3 FIELD QUALITY CONTROL

A. Tests and Inspections:
   1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification.
   2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
B. Enclosed switches will be considered defective if they do not pass tests and inspections.

3.4 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
SECTION 262913 - ENCLOSED CONTROLLERS

PART 1 - GENERAL

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

1.2 SUMMARY
   A. Section includes the following enclosed controllers rated 600 V and less:
      1. Full-voltage manual.

1.3 SUBMITTALS
   A. Shop Drawings: For each enclosed controller.
   B. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and
      arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

1.4 QUALITY ASSURANCE
   A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70,
      by a qualified testing agency, and marked for intended location and application.
   B. Comply with NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING
   A. Store enclosed controllers indoors in clean, dry space with uniform temperature to prevent
      condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive
      substances, and physical damage.

1.6 COORDINATION
   A. Coordinate layout and installation of enclosed controllers with other construction including
      conduit, piping, equipment, and adjacent surfaces. Maintain required clearances.
PART 2 - PRODUCTS

2.1 FULL-VOLTAGE CONTROLLERS

A. General Requirements for Full-Voltage Controllers: Comply with NEMA ICS 2, general purpose, Class A.

B. Fractional Horsepower Manual Controllers: "Quick-make, quick-break" toggle action; marked to show whether unit is off, on, or tripped.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Eaton.
   b. General Electric.
   c. Siemens.
   d. Square D.
   e. Or equal.


3. Overload Relays: Inverse-time-current characteristics; heaters matched to nameplate full-load current of actual protected motor; melting alloy type.

4. Flush mounting in finished areas and surface mounting in unfinished areas.

2.2 ENCLOSURES

A. Enclosed Controllers: NEMA ICS 6, to comply with environmental conditions at installed location.

1. Dry and Clean Indoor Locations: Type 1.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and surfaces to receive enclosed controllers, for compliance with requirements and other conditions affecting performance of the Work.

B. Examine enclosed controllers before installation. Reject enclosed controllers that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install heaters in thermal overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.
3.3 IDENTIFICATION

A. Identify enclosed controllers. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

1. Identify field-installed conductors.
2. Label each enclosure with engraved nameplate.

3.4 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
2. Test continuity of each circuit.
3. Test each motor for proper phase rotation.
5. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

B. Enclosed controllers will be considered defective if they do not pass tests and inspections.

3.5 PROTECTION

A. Replace controllers whose interiors have been exposed to water or other liquids prior to Substantial Completion.

END OF SECTION 262913
SECTION 262923 - VARIABLE-FREQUENCY MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes separately enclosed, preassembled, combination VFCs, rated 600 V and less, for speed control of three-phase, squirrel-cage induction motors.

1.2 ACTION SUBMITTALS

A. Product Data: For each type and rating of VFC indicated.

B. Shop Drawings: For each VFC indicated.

1. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

2. Include diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Seismic Qualification Certificates: For each VFC, accessories, and components, from manufacturer.


2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based, and their installation requirements.

C. Product certificates.

D. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.
1.6 WARRANTY
   A. Special Warranty: Manufacturer agrees to repair or replace VFCs that fail in materials or
      workmanship within specified warranty period.
      1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
   A. Manufacturers: Subject to compliance with requirements, provide the following:
      1. ABB Low Voltage HVAC Drives, model ACH550 with E-clipse bypass.

2.2 SYSTEM DESCRIPTION
   A. General Requirements for VFCs:
      1. VFCs and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing
         agency, and marked for intended location and application.
      2. Comply with NEMA ICS 7, NEMA ICS 61800-2, and UL 508C.

   B. Application: Variable torque.

   C. VFC Description: Variable-frequency motor controller, consisting of power converter that
      employs pulse-width-modulated inverter, factory built and tested in an enclosure, with integral
      disconnecting means and overcurrent and overload protection; listed and labeled by an NRTL as
      a complete unit; arranged to provide self-protection, protection, and variable-speed control of
      one or more three-phase induction motors by adjusting output voltage and frequency.
      1. Units suitable for operation of NEMA MG 1 motors.
      2. Listed and labeled for integrated short-circuit current (withstand) rating by an NRTL
         acceptable to authorities having jurisdiction.

   D. Design and Rating: Match load type, such as fans, blowers, and pumps; and type of connection
      used between motor and load such as direct or through a power-transmission connection.

   E. Output Rating: Three phase; 10 to 60 Hz, with voltage proportional to frequency throughout
      voltage range; maximum voltage equals input voltage.

   F. Unit Operating Requirements:
      1. Input AC Voltage Tolerance: Plus 10 and minus 10 percent of VFC input voltage rating.
      2. Input AC Voltage Unbalance: Not exceeding 3 percent.
3. Input Frequency Tolerance: Plus or minus 3 percent of VFC frequency rating.
4. Minimum Efficiency: 97 percent at 60 Hz, full load.
5. Minimum Displacement Primary-Side Power Factor: 98 percent at nominal load.
6. Minimum Short-Circuit Current (Withstand) Rating: 100 kA.
7. Ambient Temperature Rating: Not less than 32 deg and not exceeding 104 deg.
8. Humidity Rating: Less than 95 percent (noncondensing).
10. Overload Capability: 1.1 times the base load current for 60 seconds; minimum of 1.8 times the base load current for three seconds.
11. Starting Torque: Minimum 100 percent of rated torque from 3 to 60 Hz.
12. Stop Modes: Programmable; includes fast, free-wheel, and dc injection braking.

G. Inverter Logic: Microprocessor based, isolated from all power circuits.

H. Isolated Control Interface: Allows VFCs to follow remote-control signal over a minimum 40:1 speed range.


I. Internal Adjustability Capabilities:

1. Minimum Speed: 5 to 25 percent of maximum rpm.
2. Maximum Speed: 80 to 100 percent of maximum rpm.
3. Acceleration: 0.1 to 1800 seconds.
4. Deceleration: 0.1 to 1800 seconds.
5. Current Limit: 30 to minimum of 150 percent of maximum rating.

J. Self-Protection and Reliability Features:

1. Surge Suppression: Factory installed as an integral part of the VFC, complying with UL 1449 SPD, Type 1 or Type 2.
2. Loss of Input Signal Protection: Selectable response strategy, including speed default to a percent of the most recent speed, a preset speed, or stop; with alarm.
4. Inverter overcurrent trips.
5. VFC and Motor-Overload/Overtemperature Protection: Microprocessor-based thermal protection system for monitoring VFCs and motor thermal characteristics, and for providing VFC overtemperature and motor-overload alarm and trip; settings selectable via the keypad.
6. Critical frequency rejection, with three selectable, adjustable deadbands.
7. Instantaneous line-to-line and line-to-ground overcurrent trips.
10. Short-circuit protection.
11. Motor-overtemperature fault.
K. Automatic Reset/Restart: Attempt three restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction; adjustable delay time between restart attempts.

L. Bidirectional Autospeed Search: Capable of starting VFC into rotating loads spinning in either direction and returning motor to set speed in proper direction, without causing damage to drive, motor, or load.

M. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.

N. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.

O. Integral Input Disconnecting Means and OCPD: UL 489, thermal-magnetic circuit breaker with pad-lockable, door-mounted handle mechanism.

1. Disconnect Rating: Not less than 115 percent of NFPA 70 motor full-load current rating or VFC input current rating, whichever is larger.
2. Auxiliary Contacts: NO or NC, arranged to activate before switch blades open.
3. Alarm contact that operates only when circuit breaker has tripped.

2.3 CONTROLS AND INDICATION

A. Status Lights: Door-mounted LED indicators displaying the following conditions:

1. Power on.
2. Run.
3. Overvoltage.
4. Line fault.
5. Overcurrent.

B. Panel-Mounted Operator Station: Manufacturer's standard front-accessible, sealed keypad and plain-English-language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.

1. Keypad: In addition to required programming and control keys, include keys for HAND, OFF, and AUTO modes.
2. Security Access: Provide electronic security access to controls through identification and password with at least one level of access: View only; view and operate; and view, operate, and service.

   a. Control Authority: Supports at least four conditions: Off, local manual control at VFC, local automatic control at VFC, and automatic control through a remote source.
C. Historical Logging Information and Displays:

1. Real-time clock with current time and date.
2. Running log of total power versus time.
3. Total run time.
4. Fault log, maintaining last twenty faults with time and date stamp for each.

D. Indicating Devices: Digital display mounted flush in VFC door and connected to display VFC parameters including, but not limited to:

1. Output frequency (Hz).
5. Motor torque (percent).
6. Fault or alarming status (code).
7. PID feedback signal (percent).
8. DC-link voltage (V dc).
9. Set point frequency (Hz).
10. Motor output voltage (V ac).

E. Control Signal Interfaces:

1. Electric Input Signal Interface:
   a. A minimum of two programmable analog inputs: 0- to 10-V dc and 4- to 20-mA dc.
   b. A minimum of six multifunction programmable digital inputs.

2. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the DDC system for HVAC or other control systems:
   a. 0- to 10-V dc.
   b. 4- to 20-mA dc.
   c. Potentiometer using up/down digital inputs.
   d. Fixed frequencies using digital inputs.

3. Output Signal Interface: A minimum of two programmable analog output signal(s) (0- to 10-V dc and 4- to 20-mA dc, which can be configured for any of the following:
   a. Output frequency (Hz).
   b. Output current (load).
   c. DC-link voltage (V dc).
   d. Motor torque (percent).
   e. Motor speed (rpm).
   f. Set point frequency (Hz).
2.4 BYPASS SYSTEMS

A. Bypass Operation: Manually transfers motor between power converter output and bypass circuit. Unit is capable of stable operation (starting, stopping, and running) with motor completely disconnected from power converter.

B. Bypass Mode: Manual operation only; requires local operator selection at VFC. Transfer between power converter and bypass contactor, and retransfer shall only be allowed with the motor at zero speed.

C. Bypass Controller: Two-contactor-style bypass allows motor operation via the power converter or the bypass controller; with input isolating switch and barrier arranged to isolate the power converter and permit safe troubleshooting and testing, both energized and de-energized, while motor is operating in bypass mode.

3. Isolating Switch: Non-load-break switch arranged to isolate power converter and permit safe troubleshooting and testing of the power converter, both energized and de-energized, while motor is operating in bypass mode; pad-lockable, door-mounted handle mechanism.

D. Bypass Contactor Configuration: Full-voltage (across-the-line) type.

1. NORMAL/BYPASS selector switch.
2. HAND/OFF/AUTO selector switch.
3. NORMAL/TEST Selector Switch: Allows testing and adjusting of VFC while the motor is running in the bypass mode.
   a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.
   b. Power Contacts: Totally enclosed, double break, and silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.

5. Control Circuits: Obtained from integral CPT, with primary and secondary fuses of sufficient capacity to operate all integral devices and remotely located pilot, indicating, and control devices.
   a. CPT Spare Capacity: 100 VA.

2.5 **OPTIONAL FEATURES**
   
   A. Communication Port: RS-232 port, USB 2.0 port, or equivalent connection capable of connecting a notebook computer.

2.6 **ENCLOSURES**
   
   A. VFC Enclosures: UL Type 12.

2.7 **ACCESSORIES**
   
   A. General Requirements for Control-Circuit and Pilot Devices: NEMA ICS 5; factory installed in VFC enclosure cover unless otherwise indicated.


   C. Cooling Fan and Exhaust System: UL 508 component recognized: Supply fan, with composite intake and exhaust grills and filters; power obtained from integral CPT.

**PART 3 - EXECUTION**

3.1 **INSTALLATION**
   
   A. Wall-Mounting Controllers: Install with tops at uniform height and with disconnect operating handles not higher than 79 inches above finished floor, unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not on walls, provide freestanding racks complying with Section 260529 "Hangers and Supports for Electrical Systems."

   B. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.

   C. Comply with NECA 1.

3.2 **CONTROL WIRING INSTALLATION**
   
   A. Install wiring between VFCs, and remote devices.

   B. Bundle, train, and support wiring in enclosures.
3.3 IDENTIFICATION

A. Identify VFCs, components, and control wiring. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

1. Label each VFC with engraved nameplate.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections with the assistance of a factory-authorized service representative.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each VFC element, bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

1. Inspect VFC, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
2. Test continuity of each circuit.
3. Verify that voltages at VFC locations are within 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Owner before starting the motor(s).
4. Test each motor for proper phase rotation.
5. Perform tests according to the Inspection and Test Procedures for Adjustable Speed Drives stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
6. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
7. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. VFCs will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies the VFC and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.5 ADJUSTING

A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.
B. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

C. Adjust the trip settings of instantaneous-only circuit breakers and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Initially adjust to 6 times the motor nameplate full-load amperes and attempt to start motors several times, allowing for motor cool-down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed 8 times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Owner before increasing settings.

D. Set the taps on reduced-voltage autotransformer controllers.

E. Set field-adjustable circuit-breaker trip ranges.

3.6 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, reprogram, and maintain VFCs.

END OF SECTION 262923
SECTION 265100 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Interior lighting fixtures.
2. Exit signs.
3. Lighting fixture supports.

B. Related Sections:

1. Division 26 Section "Lighting Control Devices" for automatic control of lighting, including vacancy sensors.
2. Division 26 Section "Wiring Devices" for manual switches.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.
B. CRI: Color-rendering index.
C. LER: Luminaire efficacy rating.
D. Lumen: Measured output of lamp and luminaire, or both.
E. Luminaire: Complete lighting fixture, including ballast housing if provided.

1.4 SUBMITTALS

A. Shop Drawings: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:

1. Physical description of lighting fixture including dimensions.
2. LED drivers.
3. Life, output (lumens, CCT, and CRI), and energy-efficiency data.
4. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing & Calculation Guides, of each lighting fixture type.
5. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

6. Wiring Diagrams: For power, signal, and control wiring.

B. Operation and Maintenance Data: The following products shall be included in the operation and maintenance manuals:
   1. Light fixtures.

C. Warranty: Sample of special warranty.

1.5 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NFPA 70.

1.6 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.7 WARRANTY

A. Warranty for LED lamped fixtures: Drivers shall have a minimum warranty period of 5 years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide product indicated on Drawings.

2.2 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

A. Metal Parts: Free of burrs and sharp corners and edges.

B. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.
C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during maintenance and when secured in operating position.

D. Diffusers and Globes:
   1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
      a. Lens Thickness: At least 0.125 inch minimum unless indicated otherwise on Drawings.
      b. UV stabilized.

2.3 EXIT SIGNS

A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:
   1. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.

2.4 LIGHTING FIXTURE SUPPORT COMPONENTS

A. Comply with Division 26 Section "Hangers and Supports for Electrical Systems" for channel-and angle-iron supports and nonmetallic channel and angle supports.

B. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.


D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Lighting fixtures:
   1. Set level, plumb, and square with ceilings and walls unless otherwise indicated.

B. Temporary Lighting: If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstate.
C. Lay-in Ceiling Lighting Fixtures Supports: Use grid as a support element.
   1. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each fixture. Locate not more than 6 inches from lighting fixture corners.
   2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
   3. Install at least one independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.

D. Suspended Lighting Fixture Support:
   1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
   3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
   4. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.

E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.2 IDENTIFICATION
   A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL
   A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation.

END OF SECTION 265100
SECTION 284621.11 - ADDRESSABLE FIRE-ALARM SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   2. System smoke detectors.

1.3 DEFINITIONS

A. EMT: Electrical Metallic Tubing.
B. FACP: Fire Alarm Control Panel.
C. NICET: National Institute for Certification in Engineering Technologies.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product, including furnished options and accessories.
   1. Include construction details, material descriptions, dimensions, profiles, and finishes.
   2. Include rated capacities, operating characteristics, and electrical characteristics.

B. Shop Drawings: For fire-alarm system.
   1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
   2. Include plans, elevations, sections, details, and attachments to other work.
   3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
   4. Detail assembly and support requirements.
   5. Include voltage drop calculations for notification-appliance circuits.
   6. Include battery-size calculations.
7. Include input/output matrix.
8. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.
9. Include performance parameters and installation details for each detector.
10. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
11. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale; coordinate location of duct smoke detectors and access to them.
   a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
   b. Show field wiring required for HVAC unit shutdown on alarm.
   c. Locate detectors according to manufacturer's written recommendations.
12. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.

C. General Submittal Requirements:
   1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
   2. Shop Drawings shall be prepared by persons with the following qualifications:
      a. Trained and certified by manufacturer in fire-alarm system design.
      b. NICET-certified, fire-alarm technician; Level III minimum.
      c. Licensed or certified by authorities having jurisdiction.

1.5 INFORMATIONAL SUBMITTALS
   A. Qualification Data: For Installer.
   B. Field quality-control reports.
   C. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS
   A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.
      1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following and deliver copies to authorities having jurisdiction:
         a. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
         b. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
c. Complete wiring diagrams showing connections between all devices and equipment. Each conductor shall be numbered at every junction point with indication of origination and termination points.
d. Riser diagram.
e. Device addresses.
f. Record copy of site-specific software.
g. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:

1) Equipment tested.
2) Frequency of testing of installed components.
3) Frequency of inspection of installed components.
4) Requirements and recommendations related to results of maintenance.
5) Manufacturer's user training manuals.

h. Manufacturer's required maintenance related to system warranty requirements.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Smoke Detectors: No fewer than one unit of each type.
2. Detector Bases: No fewer than one unit of each type.
3. Keys and Tools: One extra set for access to locked or tamperproofed components.
4. Audible and Visual Notification Appliances: One of each type installed.
5. Fuses: Two of each type installed in the system. Provide in a box or cabinet with compartments marked with fuse types and sizes.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level II technician.

C. NFPA Certification: Obtain certification according to NFPA 72 by an NRTL (nationally recognized testing laboratory).

1.9 PROJECT CONDITIONS

A. Perform a full test of the existing system prior to starting work. Document any equipment or components not functioning as designed.
B. Interruption of Existing Fire-Alarm Service: Do not interrupt fire-alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:

1. Notify Owner no fewer than seven days in advance of proposed interruption of fire-alarm service.
2. Do not proceed with interruption of fire-alarm service without Owner's written permission.

C. Use of Devices during Construction: Protect devices during construction unless devices are placed in service to protect the facility during construction.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship within specified warranty period.

1. Warranty Extent: All equipment and components not covered in the Maintenance Service Agreement.
2. Warranty Period: One years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Source Limitations for Fire-Alarm System and Components: Components shall be compatible with, and operate as an extension of, existing system. Provide system manufacturer's certification that all components provided have been tested as, and will operate as, a system.

B. Noncoded, UL-certified addressable system, with multiplexed signal transmission and horn/strobe evacuation.

C. Automatic sensitivity control of certain smoke detectors.

D. All components provided shall be listed for use with the selected system.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

A. Existing system sequence of operation is existing to remain.
2.3 MANUAL FIRE-ALARM BOXES

A. Manufacturer: Notifier.

B. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
   1. Double-action mechanism requiring two actions to initiate an alarm, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
   2. Station Reset: Key- or wrench-operated switch.
   3. Indoor Protective Shield: Factory-fabricated, clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.
   4. Weatherproof Protective Shield: Factory-fabricated, clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.

2.4 SYSTEM SMOKE DETECTORS

A. Manufacturer: Notifier

B. General Requirements for System Smoke Detectors:
   1. Comply with UL 268; operating at 24-V dc, nominal.
   2. Detectors shall be two-wire type.
   3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
   4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
   5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
   6. Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
   7. Remote Control: Unless otherwise indicated, detectors shall be digital-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.
      a. Multiple levels of detection sensitivity for each sensor.
      b. Sensitivity levels based on time of day.

C. Photoelectric Smoke Detectors:
   1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
   2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
a. Primary status.
b. Device type.
c. Present average value.
d. Present sensitivity selected.
e. Sensor range (normal, dirty, etc.).

D. Duct Smoke Detectors: Photoelectric type complying with UL 268A.

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
   a. Primary status.
   b. Device type.
   c. Present average value.
   d. Present sensitivity selected.
   e. Sensor range (normal, dirty, etc.).

3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector for smoke detection in HVAC system ducts.
4. Each sensor shall have multiple levels of detection sensitivity.
5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.

2.5 NOTIFICATION APPLIANCES

A. Manufacturer: Notifier

B. General Requirements for Notification Appliances: Connected to notification-appliance signal circuits, zoned as indicated, equipped for mounting as indicated, and with screw terminals for system connections.

1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.

C. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet (3 m) from the horn, using the coded signal prescribed in UL 464 test protocol.

D. Visible Notification Appliances: Xenon strobe lights complying with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- (25-mm-) high letters on the lens.

1. Rated Light Output:
a. 15/30/75/110 cd, selecteable in the field.

2. Mounting: Wall mounted unless otherwise indicated.
3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
4. Flashing shall be in a temporal pattern, synchronized with other units.
5. Strobe Leads: Factory connected to screw terminals.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.

1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.

B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EQUIPMENT INSTALLATION

A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."

1. Devices placed in service before all other trades have completed cleanup shall be replaced.
2. Devices installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.

B. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.

1. Connect new equipment to existing control panel in existing part of the building.
2. Expand, modify, and supplement existing control and monitoring equipment as necessary to extend existing control and monitoring functions to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.

C. Manual Fire-Alarm Boxes:
1. Install manual fire-alarm box in the normal path of egress within 60 inches (1520 mm) of the exit doorway.
3. The operable part of manual fire-alarm box shall be between 42 inches (1060 mm) and 48 inches (1220 mm) above floor level. All devices shall be mounted at the same height unless otherwise indicated.

D. Smoke- or Heat-Detector Spacing:

1. Comply with the "Smoke-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.
2. Comply with the "Heat-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for heat-detector spacing.
3. Smooth ceiling spacing shall not exceed 30 feet (9 m).
4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Annex A or Annex B in NFPA 72.
5. HVAC: Locate detectors not closer than 36 inches (910 mm) from air-supply diffuser or return-air opening.
6. Lighting Fixtures: Locate detectors not closer than 12 inches (300 mm) from any part of a lighting fixture and not directly above pendant mounted or indirect lighting.

E. Install a cover on each smoke detector that is not placed in service during construction. Cover shall remain in place except during system testing. Remove cover prior to system turnover.

F. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct. Tubes more than 36 inches (9100 mm) long shall be supported at both ends.

1. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.

G. Remote Status and Alarm Indicators: Install in a visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.

H. Audible Alarm-Indicating Devices: Install not less than 6 inches (150 mm) below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Install all devices at the same height unless otherwise indicated.

I. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches (150 mm) below the ceiling. Install all devices at the same height unless otherwise indicated.

J. Device Location-Indicating Lights: Locate in public space near the device they monitor.

3.3 PATHWAYS

A. Pathways shall be installed in EMT.
B. Exposed EMT shall be painted red enamel.

3.4 CONNECTIONS

A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Section 087100 "Door Hardware." Connect hardware and devices to fire-alarm system.

1. Verify that hardware and devices are listed for use with installed fire-alarm system before making connections.

B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 36 inches (910 mm) from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.

1. Smoke dampers in air ducts of designated HVAC duct systems.
2. Magnetically held-open doors.
3. Electronically locked doors and access gates.

3.5 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."

3.6 FIELD QUALITY CONTROL

A. Field tests shall be witnessed by authorities having jurisdiction.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

D. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Visual Inspection: Conduct visual inspection prior to testing.
   a. Inspection shall be based on completed record Drawings and system documentation that is required by the "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
   b. Comply with the "Visual Inspection Frequencies" table in the "Inspection" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.

3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.

4. Test visible appliances for the public operating mode according to manufacturer's written instructions.

5. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" section of the "Fundamentals" chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

E. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

F. Fire-alarm system will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

END OF SECTION 284621.11
BUILDING CODE SUMMARY / ALTERATIONS - LEVEL 2

INTERNATIONAL EXISTING BUILDING CODE (IEBC 2015)

**OCCUPANCY**

- **TYPE OF CONSTRUCTION**
  - TYPE IIB NON-COMBUSTIBLE/UNPROTECTED FULLY SPRINKLERED

**STORIES**

- **HEIGHT**
  - 50'-0" +/-

**TOTAL ALLOWABLE AREA/FLOOR (BASEMENT)**

- **BUILDING CODE**
  - INTERNATIONAL BUILDING CODE (IBC 2015)

**FIRE RESISTANCE**

- **BEARING WALL (EXT/INT)**
- **FLOOR CONSTRUCTION**
- **NON-BEARING PARTITIONS**
- **ROOF CONSTRUCTION**
- **STRUCTURAL FRAME**
- **CORRIDOR WALLS**
- **EXTERIOR WALL (X>30 FT)**
- **STAIR SHAFTS**

**CODE OCCUPANT LOAD - BASEMENT**

- **SPACE FUNCTION**
  - S-1 (STORAGE)
  - B (BUSINESS)
  - TOTAL

- **OCCUPANTS**
  - **NET AREA**
    - 8,333 SF
    - 13,708 SF
    - 22,041 SF

**CODE OCCUPANT LOAD - BASEMENT**

- **MIN. NUMBER OF EXITS**
- **MAX. EXIT TRAVEL DISTANCE IN FEET**
- **MAX. COMMON PATH OF TRAVEL DISTANCE IN FEET**
- **MAX. DEAD-END CORRIDOR LENGTH IN FEET**

**LEGEND**

- A-3 (ASSEMBLY)
- S-1 STORAGE
- B (BUSINESS)

**PLUMBING FIXTURE CALCULATIONS**

- **WATER CLOSETS**
  - 1 PER 100 = 1
  - 1 PER 200 = 1
  - 1 PER 1000 = 1

- **LAVATORIES**
  - MALE = 65
  - FEMALE = 65
  - 1 PER 150 = 1
  - 1 PER 200 = 1
  - 1 PER 1000 = 1

- **OTHER**
  - 1 SERVICE SINK

**Whitman, Requardt & Associates, LLP**

801 South Caroline Street, Baltimore, Maryland 21231
### Fire Alarm Details

![Diagram of fire alarm details](image-url)

- Description: Detailed view of the fire alarm system's configuration.
- Details: Specific components and connections as per the diagram.

---

### General Notes

1. Review the fire alarm system's installation plan and ensure all devices are correctly connected.
2. Verify the functionality of each component by conducting regular tests.
3. Maintain all fire alarm system records and documentation for easy access.
4. Ensure proper training for all personnel regarding the operation of the system.
5. Conduct annual inspections to ensure the system is in good working condition.
6. Keep a backup copy of all system configurations and settings.

---

### Fire Alarm Legend

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Symbol 1]</td>
<td>![Description 1]</td>
</tr>
<tr>
<td>![Symbol 2]</td>
<td>![Description 2]</td>
</tr>
<tr>
<td>![Symbol 3]</td>
<td>![Description 3]</td>
</tr>
</tbody>
</table>

---

### Fire Alarm Annotations

- Annotations are included for specific sections of the fire alarm system.
- Each annotation provides additional information or instructions related to the respective part of the system.
### Variable Air Volume (VAV) Box with Heating Coil Schedule

<table>
<thead>
<tr>
<th>No.</th>
<th>FRN (Furnace)</th>
<th>FRN (Fan)</th>
<th>FRN (Zone Damper)</th>
<th>FRN (Heating Coil)</th>
<th>FRN (Air Damper)</th>
<th>FRN (MUA)</th>
<th>FRN (Valve)</th>
<th>FRN (Wiring)</th>
<th>FRN (Other)</th>
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<tr>
<td>1</td>
<td>100</td>
<td>200</td>
<td>300</td>
<td>400</td>
<td>500</td>
<td>600</td>
<td>700</td>
<td>800</td>
<td>900</td>
</tr>
<tr>
<td>2</td>
<td>100</td>
<td>200</td>
<td>300</td>
<td>400</td>
<td>500</td>
<td>600</td>
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<td>600</td>
<td>700</td>
<td>800</td>
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Note: Additional details and footnotes can be found in the document.
### EXISTING PANELBOARD ELPI

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<th>Equipment</th>
<th>Part No.</th>
<th>Description</th>
<th>Qty</th>
<th>Unit</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
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### EXISTING PANELBOARD LP1

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<th>Qty</th>
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</tbody>
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### EXISTING PANELBOARD LP2

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<th>Unit</th>
<th>Location</th>
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</thead>
<tbody>
<tr>
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</table>

### PANELBOARD RP2C

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<th>Qty</th>
<th>Unit</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**Column Notes:**
- **Equipment:** Name of equipment item.
- **Part No.:** Part number for the equipment.
- **Description:** Detailed description of the equipment.
- **Qty:** Quantity of the equipment item.
- **Unit:** Unit of measurement for the quantity.
- **Location:** Specific location where the equipment is located.
## LIGHTING FIXTURE SCHEDULE

<table>
<thead>
<tr>
<th>#</th>
<th>Description</th>
<th>Type</th>
<th>Color</th>
<th>Material</th>
<th>Size</th>
<th>Location</th>
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<tbody>
<tr>
<td>1</td>
<td>Office Light</td>
<td>LED</td>
<td>White</td>
<td>Plastic</td>
<td>200</td>
<td>Lobby</td>
</tr>
<tr>
<td>2</td>
<td>Hallway Light</td>
<td>Halogen</td>
<td>Black</td>
<td>Aluminum</td>
<td>300</td>
<td>Hallway</td>
</tr>
<tr>
<td>3</td>
<td>Dorm Room Light</td>
<td>LED</td>
<td>Red</td>
<td>Glass</td>
<td>150</td>
<td>Dorm Room</td>
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## PANELBOARD RP18

<table>
<thead>
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<th>#</th>
<th>Equipment</th>
<th>Amps</th>
<th>Volts</th>
<th>Circuit</th>
<th>Breaker</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Generator</td>
<td>200</td>
<td>120</td>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td>2</td>
<td>Switch Box</td>
<td>50</td>
<td>240</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>3</td>
<td>Transformer</td>
<td>150</td>
<td>380</td>
<td>15</td>
<td>25</td>
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## EQUIPMENT CONNECTION SCHEDULE

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<th>Equipment</th>
<th>Circuit</th>
<th>Breaker</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Generator</td>
<td>20</td>
<td>30</td>
<td>Lobby</td>
</tr>
<tr>
<td>2</td>
<td>Switch Box</td>
<td>10</td>
<td>20</td>
<td>Hallway</td>
</tr>
<tr>
<td>3</td>
<td>Transformer</td>
<td>15</td>
<td>25</td>
<td>Dorm Room</td>
</tr>
</tbody>
</table>
# Honors College, Math and CIS Renovations

7800 York Road Building  
Towson University

Finish Hardware Sets

## Door Type 1

<table>
<thead>
<tr>
<th>QUANTITY</th>
<th>ITEM</th>
<th>FINISH</th>
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<tbody>
<tr>
<td>2</td>
<td>Stanley FBB 168 4 ½” X 4 ½” Butt Hinge</td>
<td>US26D</td>
</tr>
<tr>
<td>1</td>
<td>Stanley CEFBB 168 4 ½” X 4 ½” 8 Wire Electric Hinge</td>
<td>US26D</td>
</tr>
<tr>
<td>1</td>
<td>Best IDH Max Mortise Lockset</td>
<td>626</td>
</tr>
<tr>
<td></td>
<td>45HM7 DEU 15 MS -1300</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>LCN 4040XP-RWPA Door Closer</td>
<td>626</td>
</tr>
<tr>
<td>3</td>
<td>Silencers</td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**
1. Best IDH-Max lockset provided by Access Control Contractor. Determine handing to meet door swing as designed.
2. Door prep for mortise lockset with wire channel through door from middle hinge position to mortise pocket.
3. Door Position Switch provided as part of Best IDH-Max Lockset

## Door Type 2

<table>
<thead>
<tr>
<th>QUANTITY</th>
<th>ITEM</th>
<th>FINISH</th>
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</thead>
<tbody>
<tr>
<td>3</td>
<td>Stanley FBB 168 4 ½” X 4 ½” Butt Hinge</td>
<td>US26D</td>
</tr>
<tr>
<td>1</td>
<td>Best Mortise Lockset</td>
<td>626</td>
</tr>
<tr>
<td></td>
<td>45 H7 AT 15 H</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Silencers</td>
<td></td>
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</table>

**Notes:**
1. Lockset handed to match door swing.
### Door Type 2A – Room YR 134Q

<table>
<thead>
<tr>
<th>QUANTITY</th>
<th>ITEM</th>
<th>FINISH</th>
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</thead>
<tbody>
<tr>
<td>3</td>
<td>Stanley FBB 168 4 ½” X 4 ½” Butt Hinge</td>
<td>US26D</td>
</tr>
<tr>
<td>1</td>
<td>Best Electrified Mortise Lockset 45HW 7 DEU 15 H RQE</td>
<td>626</td>
</tr>
<tr>
<td>3</td>
<td>Silencers</td>
<td></td>
</tr>
</tbody>
</table>

Notes:
1. Lockset handed to match door swing.
2. RQE Function is requested, but is for future use. RQE should be wired through the hinge and extended to the head end to be labelled and stored.

### Door Type 3

<table>
<thead>
<tr>
<th>QUANTITY</th>
<th>ITEM</th>
<th>FINISH</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Stanley FBB 168 4 ½” X 4 ½” Butt Hinge</td>
<td>US26D</td>
</tr>
<tr>
<td>1</td>
<td>Best Mortise Privacy Lock with Visual Indicator 45 H7 L 15 H VIN</td>
<td>626</td>
</tr>
<tr>
<td>1</td>
<td>LCN 4040XP-RWPA Door Closer</td>
<td>626</td>
</tr>
<tr>
<td>3</td>
<td>Silencers</td>
<td></td>
</tr>
</tbody>
</table>

Notes:
1. Lockset handed to match door swing.

### Door Type 4

<table>
<thead>
<tr>
<th>QUANTITY</th>
<th>ITEM</th>
<th>FINISH</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Stanley FBB 168 4 ½” X 4 ½” Butt Hinges</td>
<td>US26D</td>
</tr>
<tr>
<td>1</td>
<td>Von Duprin 99F-EO Fire Rated Exit Device (Left hand leaf from vestibule side.)</td>
<td>626</td>
</tr>
<tr>
<td>1</td>
<td>Von Duprin 99FL-996L-BE Fire Rated Exit Device (Right hand leaf from vestibule side.)</td>
<td>US26D</td>
</tr>
<tr>
<td>2</td>
<td>LCN 4040XP-RWPA Door Closers</td>
<td>626</td>
</tr>
<tr>
<td>1</td>
<td>Von Duprin 9954 Fixed Fire Rated Mullion</td>
<td></td>
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</table>

### Door Type 5

<table>
<thead>
<tr>
<th>QUANTITY</th>
<th>ITEM</th>
<th>FINISH</th>
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</thead>
<tbody>
<tr>
<td>5</td>
<td>Stanley FBB 168 4 ½” X 4 ½” Butt Hinges</td>
<td>US26D</td>
</tr>
<tr>
<td>1</td>
<td>Stanley CEFBB 168 4 ½” X 4 ½” 8 Wire Electric Hinge (On Active Leaf)</td>
<td>626</td>
</tr>
<tr>
<td>1</td>
<td>Best IDH Max Mortise Lockset</td>
<td>626</td>
</tr>
</tbody>
</table>
### Door Type 6

<table>
<thead>
<tr>
<th>QUANTITY</th>
<th>ITEM</th>
<th>FINISH</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Stanley FBB 168 4 ½&quot; X 4 ½&quot; Butt Hinge</td>
<td>US26d</td>
</tr>
<tr>
<td>1</td>
<td>Stanley CEFBB 168 4 ½&quot; X 4 ½&quot; 8 Wire Electric Hinge</td>
<td>US26D</td>
</tr>
<tr>
<td>1</td>
<td>Best IDH Max Mortise Lockset 45 H7 DEU 15 MS -1300</td>
<td>626</td>
</tr>
<tr>
<td>1</td>
<td>LCN 404XP-RWPA Door Closer</td>
<td></td>
</tr>
</tbody>
</table>

Notes:
1. Best IDH-Max lockset provided by Access Control Contractor. Determine handing to meet door swing as designed.
2. Door prep for mortise lockset with wire channel through door from middle hinge position to mortise pocket on active leaf.
3. Door position switch and request to exit supplied as part of Best IDH Max.

### Door Type 7

<table>
<thead>
<tr>
<th>QUANTITY</th>
<th>ITEM</th>
<th>FINISH</th>
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</thead>
<tbody>
<tr>
<td>6</td>
<td>Stanley FBB 168 4 ½&quot; X 4 ½&quot; Butt Hinge</td>
<td>US26d</td>
</tr>
<tr>
<td>1</td>
<td>Best Mortise Storeroom Lock 45 H7 D 15 H (On Active Leaf)</td>
<td>626</td>
</tr>
<tr>
<td>1</td>
<td>Set Top/Bottom Manual Flush Bolts (On Inactive Leaf)</td>
<td>626</td>
</tr>
</tbody>
</table>

Notes:
1. Lockset handed to match door swing.
### Door Type 8

<table>
<thead>
<tr>
<th>QUANTITY</th>
<th>ITEM</th>
<th>FINISH</th>
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</thead>
<tbody>
<tr>
<td>3</td>
<td>Stanley FBB 168 4 ½” X 4 ½” Butt Hinge</td>
<td>US26D</td>
</tr>
<tr>
<td>1</td>
<td>Best Mortise Lockset 45 H7 AT 15 H</td>
<td>626</td>
</tr>
<tr>
<td>3</td>
<td>Silencers</td>
<td></td>
</tr>
</tbody>
</table>

Notes:

2. Lockset handed to match door swing.

### New Storefront Entry Doors Facing York Road

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<tbody>
<tr>
<td>2</td>
<td>Von Duprin QEL-RX-33A-NL-OP Exit Device</td>
<td>626</td>
</tr>
<tr>
<td>2</td>
<td>Von Duprin EPT-10 Power Transfer</td>
<td>626</td>
</tr>
<tr>
<td>1</td>
<td>Von Duprin 4954 Fixed Mullion</td>
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</tr>
<tr>
<td>1</td>
<td>Lenel LNL-2005 Magentic Card Reader</td>
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</tr>
<tr>
<td>2</td>
<td>Door position switches.</td>
<td></td>
</tr>
</tbody>
</table>

Notes:

1. Balance of required hardware to match, including hinges and pulls, to match existing building entrances.
2. Card reader and door position switches by Access Control Contractor.
YR0129
- At Podium
  - 4 - Data drops
  - 1 - Quad Electric outlet
  - 3 - 1" conduits or a 1" and 2" conduit (must be dedicated to A/V only)

- Electric for projector
- Electric for screen

YR0128
- At Podium
  - 4 - Data drops
  - 1 - Quad Electric outlet
  - 3 - 1" conduits or a 1" and 2" conduit (must be dedicated to A/V only)

- Electric for projector
- Electric for screen

YR0130
- At Podium
  - 4 - Data drops
  - 1 - Quad Electric outlet
  - 3 - 1" conduits or a 1" and 2" conduit (must be dedicated to A/V only)

- Electric for projector
- Electric for screen

Student Lounge YR0127
- Electric for tables

Honors Study Room YR0132
- Wood backing for LCD display
- Duplex electric for LCD display
- 4 Network ports for LCD display
- Network port for computer at each station at desk level (11 total)
- Quad power outlet at each station at desk level (11 total)
- Blocking to mount computers on articulating arms at each station (11 total)
- Center desks must have power and data ports on each
**Honors Classroom 1 YR0131**

- At Credenza
  - 4 - Data drops
  - 1 - Quad Electric outlet
  - 3 - 1" conduits or a 1" and 2" conduit (must be dedicated to A/V only)

- Wood backing for LCD on each wall (4 total)
- Duplex power outlet for LCD on each wall (4 total)

**Honors Classroom 2**

- At Credenza
  - 4 - Data drops
  - 1 - Quad Electric outlet
  - 3 - 1" conduits or a 1" and 2" conduit (must be dedicated to A/V only)

- Wood backing for LCD on front and back wall (2 total)
- Duplex power outlet for LCD on front and back wall (2 total)

**Thesis/Conference**

- At Credenza
  - 4 - Data drops
  - 1 - Quad Electric outlet
  - 3 - 1" conduits or a 1" and 2" conduit (must be dedicated to A/V only)

- Electric for projector
- Electric for screen

**YR0215**

- Electric at each table

**YR0220 Collaboration Space**

- Wood backing for displays (3 total)
- Four data ports behind each display
- Duplex outlet behind each display (3 total)
- Power outlets on each table
YR0216

- At Podium
  - 4 - Data drops
  - 1 - Quad Electric outlet
  - 3 - 1" conduits or a 1" and 2" conduit (must be dedicated to A/V only)

- Network port for each desk (28 total)
- Power for each desk (28 total)
- Electric for projector
- Electric for screen

YR0218

- At Podium
  - 4 - Data drops
  - 1 - Quad Electric outlet
  - 3 - 1" conduits or a 1" and 2" conduit (must be dedicated to A/V only)

- Network port for each desk (28 total)
- Power for each desk (28 total)
- Electric for projector
- Electric for screen

YR0217

- At Podium
  - 4 - Data drops
  - 1 - Quad Electric outlet
  - 3 - 1" conduits or a 1" and 2" conduit (must be dedicated to A/V only)

- Network port for each desk (31 total)
- Power for each desk (31 total)
- Electric for projector
- Electric for screen

YR0219

- At Podium
  - 4 - Data drops
  - 1 - Quad Electric outlet
  - 3 - 1" conduits or a 1" and 2" conduit (must be dedicated to A/V only)

- Electric for projector
- Electric for screen
YR0224

- Each desk must have two network ports
- Each wall must have four network ports
- Each desk must have power outlet (10 total)

YR0221

- At Podium
  - 4 - Data drops
  - 1 - Quad Electric outlet
  - 3 - 1" conduits or a 1" and 2" conduit (must be dedicated to A/V only)

- Network port at each desk (30 total)
- Power for each desk (30 total)

- Electric for flat panel
- Wood backing for flat panel

YR0222

- At Podium
  - 4 - Data drops
  - 1 - Quad Electric outlet
  - 3 - 1" conduits or a 1" and 2" conduit (must be dedicated to A/V only)

- Network port at each desk (30 total)
- Power for each desk (30 total)

- Electric for flat panel
- Wood backing for flat panel

YR0223

- At Podium
  - 4 - Data drops
  - 1 - Quad Electric outlet
  - 3 - 1" conduits or a 1" and 2" conduit (must be dedicated to A/V only)

- Network port at each desk (30 total)
- Power for each desk (30 total)

- Electric for flat panel
- Wood backing for flat panel
Towson University
Interior Sign Program

Design Intent Document
Sign Elevations

May 7, 1999
Revised March 2007

Environmental Graphic Designer:
Portnoy Levine Design Associates
231 E. Baltimore Street, 12th floor
Baltimore, MD 21202
410/234 8998
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<td>4</td>
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<td>Sign Type Q.2: Suite Directory, 12 Names</td>
<td>17</td>
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<tr>
<td>Sign Type Q.3: Suite Directory, 20 Names</td>
<td>18</td>
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Typefaces

Rotis Semi Sans Extra Bold

Rotis Semi Sans Regular

Sabon Regular

SM 218A

Rotis Semi Sans Extra Bold

Rotis Semi Sans Regular
Color palette

Background color 1
PMS 195c

Background color 2
PMS Cool Gray 9c

Background color 1
Black
**Sign Type A Main Directory**

**George A. Smith Hall**

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</table>

Satin aluminum panel with logo silkscreened in yellow and black

Heading 1-1/2” Sabon Bold, white silkscreened

37-3/4" W x 27" H x 2-1/2" thick aluminum directory sign with protective cover holds 120 names painted background color #1

120-1/2”x9” light gray acrylic inserts. Surface silkscreened with black type.

**Typeface:**
Name or Department is 3/8” Sabon
Room number is 3/8” Rotis Extra Bold & Regular
Sign Type B
Secondary Directory

**Smith Hall**

- **SM 100 Level**
  - Receiving
  - Machine Shop

- **SM 200 Level**
  - Lecture Hall

- **SM 300 Level**
  - Center for Science & Mathematics Education
  - Dean's Office
  - Dept of Biological Services
  - Lecture Hall

- **SM 400 Level**
  - Dept. of Physics, Astronomy & Geosciences

- **SM 500 Level**
  - Dept of Chemistry
  - Lecture Hall
  - Planetarium

**Satin aluminum panel**

- **1” Sabon Bold Black, silkscreened**
- **Subsurface painted clear non-glare acrylic**
- **Color #1**
- **1” x 8” Background of Level Accent Color**
- **Typeface: 1/2” Rotis Extra Bold & Regular white vinyl**

**NOTE:** Provide 29 magnetic strips, each 3/4” high X 16” long, for text.
Sign Type C
Floor Plan/Directional

14 1/4” W x 20” H x 1” thick Poster Display System with glass door, natural aluminum frame

6” x 12” digitally printed paper map fits behind clear glass cover

5/8” Rotis Semi Sans white on Accent Color band

Surface silkscreened 12” x 18” paper Color #1

Background of Arrow Accent Color silkscreened

Typeface:
1” Rotis Semi Sans white, vinyl or silkscreened
Wheelchair symbol light gray
**College of Science and Mathematics**

**Department of Chemistry**

- **Sign Type E**
- **Department ID**
- **Color #1**
- **Typeface:**
  - 3/8” Sabon Italic white vinyl or silkscreened
  - 1” Sabon Bold white vinyl
- **1/16” Face acrylic**
- **1/16” Subsurface painted clear non-glare acrylic**
- **Satin aluminum panel (.032)**
Sign Type F

Room ID

1/16” Face acrylic
1/8” Acrylic subsurface painted clear, non-glare
Color #1
Typeface: 3/4” Rotis Extra Bold & Regular white vinyl
.040 LEXAN, clear coated intermediate sheet
1.5” x 4” satin aluminum for raised Helvetica lettering and Braille, with no surface color
Minimum spacing between lettering and Braille to be 1/4”

NOTE: Base built up to be flush with upper section photopolymer applied Braille
SM 218A
Dr. Solomon Shoemaker
SM 218

1/16" Face acrylic
1/8" Acrylic subsurface painted clear, non-glare
Color #1
Typeface: 3/4" Rotis Extra Bold & Regular white vinyl
.040 LEXAN, clear coated intermediate sheet
3/8" Sabon name in white vinyl on removable clear panel
Title: Standard Case, 1/4" Sabon
1.5” x 4” satin aluminum for raised Helvetica lettering and Braille, with no surface color
Minimum spacing between lettering and Braille to be 1/4"

NOTE: Base built up to be flush with upper section photopolymer applied Braille
1/16" Face acrylic

1/8" Acrylic subsurface painted clear, non-glare

Color #1

Typeface: 3/4" Rotis Extra Bold, white vinyl

6" Symbol light gray vinyl

Minimum spacing between lettering and Braille to be 1/4"

3" Wheelchair symbol light gray vinyl

1.5" x 8" satin aluminum for raised Helvetica lettering and braille, with no surface color

NOTE: Base built up to be flush with upper section photopolymer applied Braille
SM 100 Level

1/16” Face acrylic
1/8” Acrylic subsurface painted clear, non glare
Color #1
Typeface: 3/4” Rotis Extra Bold & Regular white vinyl
1.5”x 8” satin aluminum panel

NOTE: Base built up to be flush with upper section photopolymer applied Braille
1/16” Face acrylic
1/16” Acrylic subsurface painted clear, non glare
Typeface: 3/8” Sabon white vinyl or silkscreened
Color #2

Authorized Personnel Only

Additional message can be added to same plaque.
Typeface: 1/4” Sabon white vinyl or silkscreened

Be sure both latches are locked before closing the door
Acceptable messages for sign type K

1. Authorized personnel only
2. Faculty only
3. Please keep door closed
4. Please keep door open
5. Open door slowly
6. Please knock before entering
7. Please do not lock this door
8. Please lock this door
9. Do not open without disengaging alarm
10. Be sure both latches are locked before closing the door
11. Research in progress
12. Please enter through room SM ___
13. Temperature controlled room
14. Safety glasses required in this area
15. Learn your colors-orange, red, rust
Sign Type P
Nameplate

EMPLOYEE NAME

1/16” Face acrylic
1/16” Subsurface painted clear non glare acrylic, Color #1
Typeface: centered, all uppercase, 3/8” Sabon white vinyl or silk-screened subsurface

This mounts on the cubicle using velcro.

If the nameplate is to be located on a desk or a door, the appropriate metal frame should be provided.
Satin aluminum panel with building name silkscreened in 1” Sabon Bold Black

Heading 3/4” Sabon Bold, white silkscreened

### Hawkins Hall

**Suite Directory**

<table>
<thead>
<tr>
<th>Faculty Name</th>
<th>HH 101A</th>
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<tbody>
<tr>
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</tbody>
</table>

10” W x 5 1/2” H aluminum directory sign with protective cover - holds 6 names. Painted background color #1.

(6, 12 or 20) 1/2” x 9” light gray acrylic inserts. Surface silkscreened with black type.

**NOTE:** Text for Sign Type Q.1 also pertains to Sign Types Q.2 and Q.3 on the next two pages.

Typeface:
Name or Department is 3/8” Sabon
Room number is 3/8” Rotis Extra Bold & Regular
# Suite Directory

<table>
<thead>
<tr>
<th>Faculty Name</th>
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<tbody>
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*Note: The diagram shows the layout for Hawkins Hall's suite directory.*
Hawkins Hall
Suite Directory

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<th>Faculty Name</th>
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# Classroom Technology Standards

## A Guide for Classroom Planning

Produced by the Office of Technology Services  
Copyright © 2017 Towson University, All Rights Reserved  
Published: 12/20/2011  
Last Updated: 11/09/2018

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Classroom Taxonomy

Overview (CTSG-001)

The Office of Technology Services (OTS) works with stakeholders in the university community, vendors, manufacturers, college/departmental technology staff, and academic leadership including department chairs and deans to develop design standards for the audiovisual technology installed in Towson University’s nearly 500 classrooms that best meet the needs of the university. The goals of standardization aim to:

- Provide a comfortable, modern, flexible, easy-to-use, and reliable teaching-learning environment that accommodates a variety of instructional methods
- Design an active, engaging environment for today's generation of learners
- Provide a consistent, intuitive interface for controlling audiovisual equipment throughout the campus for faculty, staff, and students
- Ensure maximum reliability and up-time based on proven designs, components, and installation methods
- Ensure ease of support and usage by installing standard computer models and audiovisual components
- Keep the number of makes and models to a minimum so that an inventory of replacement parts such as projector lamps can be maintained
- Provide a means for easy, intuitive incorporation of end-user devices such as phones, tablets, and laptops

Classroom Audiovisual Architecture (CTSG-002)

The audiovisual industry has transitioned from an analog to digital audiovisual architecture and OTS adapted our standards to meet these demands. As part of the transition, known as the "analog sunset" in consumer and professional electronics, new devices are shipping with digital outputs only and older analog outputs are being disabled or severely limited by new content. The changes OTS made allow the University to take advantage of the latest technologies, provide better integration of digital devices brought on campus, streamline classroom design, and meet growing instructional needs.

Another trend we have been noticing is flat panels (4K or greater resolution) are beginning to replace traditional projectors and projection screens. This is already happening in spaces that don’t rely heavily on white boards,
such as conference rooms, but we see the trend likely to move to classrooms as well. Flat panels offer brighter, sharper images and are not dramatically affected by ambient light.

Classroom Technology Tiers (CTSG-003)

<table>
<thead>
<tr>
<th>STUDIO</th>
<th>High-end, high-cost, specialty technology, and venues.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Examples:</strong></td>
<td>Simulation models, digital microscopes, observation labs and recording devices, specialty control devices; concert or performance venues in which students physically use the equipment; radio and TV production; advanced distance learning suites.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CURRICULIZED</th>
<th>Course-specific technology needed for instruction to support a specific academic class, program, major, etc. Students must physically interact with the technology, which is typically not as general purpose as Extended or Foundation.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Examples:</strong></td>
<td>Specialty monitors with high-precision drawing capability; unique printers, possibly higher-end 3D and subtractive manufacturing devices; ceiling mounted document camera, ultra-high (4K) display or projection.</td>
</tr>
</tbody>
</table>

| SUPPORT | Support, training, documentation, and learning resources for faculty provided by college or department technology staff or other resources; OTS role, if applicable, limited to review of design in relation to campus standards, interaction with network and infrastructure, etc. For certain technologies and venues, OTS may play a specific, limited role in support, with roles and responsibilities articulated via memoranda of understanding. |
**EXTENDED:** Proven general-purpose technologies in which deployment is done in a deliberate, phased, or limited manner or is evolving in adoption but not yet considered foundational.

Everything included in Standard Foundation Classroom plus one or more of the significant additions listed below:
- Video conferencing system/Lecture capture system (significant addition)
- Enhanced sound system and/or microphones
- Large-screen displays in addition to the projector (significant addition)
- Multiple projectors (significant addition)

**Examples:** Mid-range video conferencing/two-way interactive distance learning installations; lecture capture systems; multiple screens or flat-panel displays; interactive solutions (MondoPad, SMART and Promethean boards, interactive projectors); fixed wireless projection features. Students must either directly interact with the technology, or the technology is used by the instructor in a way to engage students or enhance the students classroom or lab experience.

**FOUNDATION:** Proven, current-generation general-purpose audiovisual and projection systems and is core for all formal learning spaces. Contains the following:
- Widescreen projector (Full HD 1920 x 1080)
- Display screen (16 x 10 or 16 x 9 motorized, HD Progressive .09 Gain)
- In-Ceiling Speakers
- Wall plate for auxiliary audiovisual input connections
- Podium with built-in computer/touch-screen monitor
- Document camera
- Crestron DMPS3-4K-350-C control system
- Crestron TSW-760 LCD touch panel controllers
- Cable Cubby w/ Ethernet, USB, HDMI, 3.5mm audio, RCA, VGA, and power connections
- Networked via Crestron Fusion RV (RoomView)
- Dual Image multi-window processor (Except in rooms with multiple displays that provide the same functionality)

**SUPPORT**

Telephone, chat, training, documentation, and secondary in-person support (as workload permits) provided by OTS staff. College or department technology providers typically provide routine in-person or classroom-based incident support, in collaboration with OTS staff. Support roles and responsibilities between OTS and departments/colleges will typically be covered in a common campus-wide delineation of duties.
Add-Ons (Can be added to any tier)
- Wireless microphones
- Multiple screens
- Student computers
- Interactive board (SMART, Promethean, BrightLink, Infocus)
- Interactive desktop monitor

*VCRs are being retired as a primary solution and DVD drives installed in the computer as well as streaming solutions are replacing a separate media player

**Add-ons (CTSG-004)**

A. **Crestron AM-100** (AirMedia Presentation Gateway) allows clients to wirelessly project material from Windows and Mac computers as well as iOS and Android mobile devices. The following settings must be in place for every AirMedia that is added to a TU system.

In rooms with Crestron control systems, the programming must be updated to add a button to the source list on the Crestron touch panel labeled “Wireless Input”. The button must have the same size, color, and font size as all other sources.

The network port must be on the Learning Spaces VLAN.

On the management interface of the AirMedia device the following settings must be made:

- Set Admin Password (See Instructional Services Engineer for password)
- Code must be set to Random (Device Setup>Code>Random)
- Host names must consist of the Collection Code with “-AirMedia” added to the end (i.e. CK0006-AirMedia) (Network Setup> Host Name> Collection Code-AirMedia)
- The TU logo must be set as the background (OSD Setup> Upload https://webapps.towson.edu/classroomtechnology/web_documents/tulogo_c.jpg)
- The display of the IP address must be turned off (Network Setup>Display of IP address> Off)
- **Disable the built-in DHCP server**
  - Right click and save the configuration file to your desktop: am-100_dhcp_server_off.conf (55 bytes)
  - Load the downloaded configuration file to the AirMedia via the 'System Configuration' section of the AM-100 web interface.
  - Once completed, the DHCP server will no longer be running on the AM-100.

B. **Apple TV** allows clients to wirelessly project from Apple devices such as MacBooks, iPhones, and iPads.

In rooms with Crestron control systems, the programming must be updated to add a button to the source
list on the Crestron touch panel labeled “Wireless Input”. The button must have the same size, color, and font size as all other sources. Controls must also be added (see image in Appendix A).

The Apple TV must be plugged into a network port on the Learning Spaces VLAN.

On the menu interface (accessed by pressing the menu button on the remote) the following settings must be made:

1. The device name must be changed to follow the standard naming convention: Collection Code-AppleTV (i.e. HH0313-AppleTV) (Settings>General>Name>Custom)
2. The time zone must be set correctly (Settings>General>Time Zone)
3. The serial number must be collected and entered into the TechInfo database (Settings>General>About)
4. Set Sleep time to “Never” (Settings>General>Sleep)
5. Set Screen Saver to “Never” (Settings>Screen Saver>Start After)
6. Set AirPlay security to “Onscreen Code” (Settings>AirPlay>Security)
7. Turn on Conference room Display (Settings>AirPlay>Conference Room Display)
8. Turn on Restrictions (Settings>General>Restrictions)
   o Passcode (set to standard)
   o AirPlay Settings (set to “Ask”)
9. Turn on Automatic Updates (Settings>System>Software Updates)

C. Mersive Solstice allows clients to wirelessly project material from Windows and Mac computers as well as iOS and Android mobile devices. The following settings must be in place for every Solstice Pod that is added to a TU system.

1. Display Tab
   a. Under “Naming and Discover”
      i. Display Name: Room collection code-SolsticePod (i.e. CK0008-SolsticePod)
   b. Under “Access Control”
      i. Access Control: Check Screen Key (unless moderated mode is desired by the client)
   c. Under “Resource Restriction”
      i. Check everything including “Enable AirPlay Discovery Proxy”
   d. Under “System”:
      i. Set Admin password to standard
ii. Update host name to match display name

2. Network tab
   a. Under “Wireless Settings”
      i. Uncheck “enable”

3. A “Wireless Input” button must be added to the Crestron touch panel if applicable.

Projector Configuration Requirements (CTSG-005)

1. Any setting that shuts down a projector based on the loss of signal must be disabled.

Classroom Computer Configuration Requirements (CTSG-006)

A. Overview

A classroom computer is primarily used to present information to classes by using a projector and is shared by multiple faculty. Classroom computers are critical to instruction and are configured with security settings and file management measures to preserve system integrity and assure that the computer runs consistently at an optimum level of performance. Because many people share the computer, it is different than a personal computer in an office or home. Personal files must not be stored on this computer but stored on H:\ drives (recommended) or portable media (less reliable). Installation of special software is managed with several options (listed below) to accommodate faculty needs. Software installed on the computer will be upgraded regularly in a timely manner that does not disrupt instruction.

Windows-based PCs will be the primary solution, with interactive monitors in new venues where budget permits. In some departments there may be a need for both Windows and Mac Operating Systems. In these cases a dual-boot Mac will be deployed so the faculty member can choose which OS they wish to use when starting the system.

B. Classroom computer standards

1. A base lab image and imaging process is provided by OTS, see the TU Lab Managers SharePoint site for more information: https://tu.sharepoint.com/sites/ctc/tulabs/default.aspx

2. Computers follow classroom Active Directory guidelines

3. Users logon as Users (not Administrators)

4. Classroom-specific group policy is applied

5. Classroom PCs are part of their own Configuration Manager collection for managing installation packages, etc.

6. Remote Desktop is enabled
7. BIOS is set to have the computer automatically power on at night

8. The computer is configured with standard university software (below). If special software is needed, several options are available:

9. Install software on an office computer and use Remote Desktop to access the software on that computer (recommended)

10. Virtual Workspace access

11. If software is not available in Run Advertised Programs, please discuss software needs with your department head or technology coordinator.

12. Shutdown must be disabled

13. PC must be set to automatically restart at night

14. Group Policy is set so that the PC never sleeps.

15. Group Policy is set so the monitor doesn’t sleep until after 90 min.

16. Group Policy is set so screen saver doesn’t start until 60 min.

17. Group Policy is set not to show last logged on user:
   Computer Configuration\Windows Settings\Security Settings\Local Policies\Security Options
   Do not display last user name in logon screen = Enabled

18. Group Policy is set to delete profiles

19. Group Policy is set to disable “Welcome Screen”

C. Software Included on Standard Configuration

- Microsoft Windows 10 Enterprise and Updates
- Microsoft Office 2016 Enterprise (Includes Word, Excel, Access, Outlook, Power Point, & Publisher) and Updates
- Microsoft Internet Explorer and Updates
- Firefox
- Microsoft System Center Endpoint Protection
- .Net Framework
- Microsoft System Center Configuration Manager Client
- Towson System Information – Allows you to quickly get information about your computer
- Citrix XenApp web client for Virtual Workspace
- Roxio Creator
- Cyberlink Power DVD
- Adobe Reader
- Windows Media Player
- Adobe Flash Player
- Adobe Shockwave Player
- VLC
- Filezilla Client
- Microsoft Silverlight
- Microsoft VisioViewer
- Java
D. **Classroom Organizational Unit (OU)**

1. A Classrooms OU exists at: towson.edu/Computer Accounts/Lab and Public/Classrooms and Conference Rooms

2. Under the \Classrooms and Conference Rooms OU, there are separate OUs for each university building; each building OU will contain the classroom computer accounts, groups, group policy, etc.

3. The plan is to move existing classroom computers into their appropriate Classrooms and Conference Rooms/Building OUs; create new computer accounts with the standard naming convention below.

4. Managers of the Classrooms and Conference Rooms OU that can create computer accounts, etc. are in the Smart Classroom Administrators group.

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E. **Standard Classroom Computer Naming Convention**

To identify classroom computers, a standard naming convention was established as follows: CLS-BuildingRoomNumber-01, 02, etc.

IMPORTANT: room numbers need to use the 4-digit number, used by Facilities. Some of the early CLS-computer accounts did not use the standard 4-digit room number; these computer accounts must be renamed when time permits)

**Example:** two computers installed in the Cook-404A classroom would have the following names:

- CLS-CK0404A-01
- CLS-CK0404A-02

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F. **Lab - Classroom Computers**

Some classrooms are also computer labs that have their own Lab OU and computer naming convention. In these cases the instructor computer can be located in the lab OU but MUST be named using the standard naming convention outlined above.

An example of a lab–classroom instructor computer account is: CLS-ES0107-01

An example of a lab-classroom student computer account is: ES0107-02, ES0107-03, etc.

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G. **InFocus MondoPad**

The PC appliance must be treated similarly to a regular classroom PC. There is currently a standard image available that will configure most settings (other than adding a maildrop) please contact Instructional Services Engineer for details. The following items must be done for each:

1. Join to domain
2. Install SCCM
3. Install endpoint protection
4. Name properly (CLS-CollectionCode-MOND)
5. Add WKST Admin group
6. Change Mondopad logo to TU logo
7. Enable minimize button for non-admin accounts under Settings>General
8. Set browser homepage to www.towson.edu
9. Install Microsoft Office
10. Install Microsoft Lync, Skype, Flash, Adobe Reader, Citrix, Shockwave, Java, VLC, Firefox, Chrome (with Remote Desktop plugin), Panopto, and Visio Viewer
11. Set up maildrop (CollectionCode-Mondopad@towson.edu). The password must be set not to expire and stored in KeePass. See Knowledge Center Article:
   https://www.towson.edu/knowledgecenter/admin/adminarticle.aspx?article=823&searchtype=IT
12. Printers can be added by the department like a regular Windows PC
13. Set passcodes (4-pin Admin)
14. SSID must match computer name
15. Add Athena local admin account with same password as the regular image
16. Add short cuts for Lync, Skype, and Office
17. Follow campus standards for BIOS settings (except for SATA operation):
   https://www.towson.edu/knowledgecenter/admin/adminarticle.aspx?article=763&searchtype=IT

Classroom Standard Equipment (CTSG-007)

Document Cameras

ELMO P30HD (Standard)

- The ELMO P30HD is the university's standard document camera, it can show high-quality images and integrate with other ELMO products or a PC. This document camera is the best choice in the majority of classroom installations.

Manufacturers Link: http://www.elmousa.com/p30hd-visual-presenter

WolfVision VZ-8plus4

- The WolfVision VZ-8plus3 provides a slightly warmer color due to the use of a halogen lamp. In a side by side comparison there was minimal differences in image quality when compared to the standard ELMO P30HD, but it is twice the cost. This document camera is only practical for projects with external funding sources or situations where slight differences in color are vital for teaching, such as an art class.

Manufacturers Link: http://www.wolfvision.com/

WolfVision VZ-3

- The WolfVision VZ-3 is a competitor to the ELMO document camera mentioned above. It offers a smaller footprint, LED lighting, and easy to use one arm design.


WolfVision EYE-12
The WolfVision EYE-12 is a Ceiling Visualizer that is mounted above a flat surface and allows everything in its field of vision to be projected. This is ideal for situations that call for large objects to be demonstrated to a class.


**Projectors**

**Panasonic PT-RZ570 (Standard)**

- The Panasonic PT-RZ370 is a full HD (1920 x 1080) 5,000 lumen projector that uses a laser light source. This design requires no lamp replacement or filter cleaning and has a virtually instant on/off time.

Manufacturers Link: [http://panasonic.net/avc/projector/products/rz570/](http://panasonic.net/avc/projector/products/rz570/)

**Sony VPL-FHZ57**

- The Sony VPL-FHZ57 is a full HD (1920 x 1200) 4,1000 lumen projector that uses a laser light source. This design requires no lamp replacement or filter cleaning and has a virtually instant on/off time.


**Panasonic PT-RZ370 (Previous Standard)**

- The Panasonic PT-RZ370 is a full HD (1920 x 1080) projector that uses an LED/laser-combined light source. This design requires no lamp replacement or filter cleaning and has a virtually instant on/off time.

Manufacturers Link: [http://panasonic.net/avc/projector/products/rz370/](http://panasonic.net/avc/projector/products/rz370/)

**Sanyo PLC-WU3800 (Previous Standard)**

- The Sanyo PLC-WU3800 is the university's previous standard projector and meets the needs of most classrooms. It offers WXGA resolutions and 3800 lumens. It also has a small footprint making it portable for mobile installations.


**Panasonic PT-EZ580U**

- The PT-EZ580U is a 5,400 lumen WUXGA resolution (1,920 x 1,200) projector that is perfect for large venues or rooms that require more advanced projection capabilities.

**Epson BrightLink 450Wi**
• The Epson BrightLink 450Wi is an "interactive projector" allowing a pen to be used to control motions and annotations on the screen. The projector is mounted directly above the projection surface so it can fit in many different size rooms. It also has a very low lamp replacement cost.

Manufacturers link: www.epson.com/brightlink

Epson PowerLite Pro Z8000WUNL

• The Epson PowerLite Pro Z8000WUNL features high color output, high lumen output, and WUXGA high definition widescreen resolution. This makes it appropriate for large venues such as large tiered lecture halls, concert halls, theaters, etc.

Manufacturers link: http://www.epson.com/cgi-bin/Store/jsp/Product.do?BV_UseBVCookie=no&sku=V11H266920

Panasonic PT-FW300U (LA Phase 1 & 2)

• The Panasonic PT-FW300U has a limited distribution (LA Building only) and its main feature is the auto advance filter, which allows it to run longer without a filter replacement. It is also larger, meaning less chance of theft, and has wireless capabilities (which are not practical in our environment).


Epson PowerLite 1760W Multimedia Projector

• The Epson PowerLite 1760W Multimedia Projector is a small portable ultralight. It is easy to carry since it is the size of a laptop. This is appropriate for situations where a projector is not permanently installed in a room.

Manufacturers link: http://www.epson.com/cgi-bin/Store/jsp/Product.do?sku=V11H361120&BV_UseBVCookie=yes

3D Projection

• Please inquire

Speakers

Atlas FAP62T

• The Atlas FAP62 is an in-ceiling loudspeaker with 32-watt 70/100V transformer and ported enclosure

Manufacturers link: https://www.atlasied.com/fap62t

Cable Access Enclosure
Extron Cable Cubby 700

- The Cable Cubby 700 includes connections for Ethernet, USB, HDMI, 3.5mm audio, RCA, VGA, and power connections


Annotation Devices

Promethean ActivBoard +2 Fixed 300 Pro

- The Promethean ActivBoard is an interactive whiteboard with dual user functionality.


SMART Board 685ix

- The SMART Board 685ix is a widescreen interactive whiteboard with an ultra-short-throw projector attached that helps to eliminate shadows, glare and distracting projector light.

Manufacturers link: http://smarttech.com/us/Solutions/Education+Solutions/Products+for+education/Interactive+whiteboards+and+displays/SMART+Board+interactive+whiteboards/685ix+for+education

Audience Response Systems

Trial sets are available for short-term loans. Allow 3-4 weeks lead time prior to using in class. Using clickers requires the pre-installation of software on faculty member’s office PCs for practice and the installation of software on classroom PCs. We realize there are other clickers on the market from other manufactures. If you would like to explore other options, obtain further information, or reserve one of the kits, please contact Cindy Davis, manager, Classroom Technology, at 410-704-3182 or c.davis@towson.edu.

Promethean ActivExpression

- Promethean ActivExpression allows for students to respond in full sentences as well as responding in numbers, symbols, math equations, true/false and others. It interfaces with Promethean Boards; however, text input can be cumbersome since it does not have a full keyboard.

Manufacturers link: http://www.prometheanworld.com/server.php?show=nav.15997

SMART Response XE ASR
- The SMART Response XE ASR has a full QWERTY keyboard to allow for short answer textual responses and interfaces with SMART Podiums and Boards. This may be overkill in situations where only yes/no style feedback is needed.


**Turning Technologies RCR-02**

- The Turning Technologies RCR-02 has the fewest buttons of the three which leads to a somewhat cumbersome interface.


**Monitors**

**Planar PCT2485**

- Standard desktop computer monitor for instructor computers


**Dell 22” Widescreen Monitor**

- Standard desktop computer monitor for lab computers


**ViewSonic TD2220**

- This optical touch monitor (can use stylus or finger tips) allows for instructors to bring interactivity to their lecture material. With a 22” display it provides a large workspace that makes it easier to engage students with content like videos and images.


**SMART Podium SP524 (Previous Standard)**

- The SMART Podium allows for instructors to bring interactivity to their lecture material. With a 24” display it provides a large workspace that makes it easier to engage students with content like videos and images. The SMART Board also integrates seamlessly with the existing technology in classrooms.

- Cost is extreme, $2500+

Manufacturers link: [http://smarttech.com/us](http://smarttech.com/us)
Audiovisual System + Interface

- The university standardized on Crestron as the primary audiovisual control system and is currently moving all classrooms onto the university network to allow remote management using Crestron Fusion RV (formerly known as RoomView).

Crestron DMPS3-4K-350-C (Standard)

- The Crestron DMPS3-4K-350-C is an AV control system, switcher, mic mixer, and amplifier.

Manufacturers link: https://www.crestron.com/products/model/DMPS3-4K-350-C

Crestron TSW-760 (Standard)

- The Crestron TSW-760 is a 7" touch screen with an edge-to-edge glass screen for higher durability. It supports the latest "Smart Graphics" from Crestron and has a 1024 x 600 screen resolution.

Manufacturers link: http://www.crestron.com/products/model/TSW-760

Crestron TPS-6L (Previous Standard)

- The Crestron TPS-6L Touch panel system allows for high-end performance and simple control over a variety of devices. With 12 optional push buttons the Crestron TPS-6L will give fast access to the most commonly used functions in a classroom.

Manufacturers link: http://www.crestron.com/resources/product_and_programming_resources/catalogs_and_brochures/online_catalog/default.asp?jump=1&model=tps-6l#

HDMI Extenders

- For rooms without digital Crestron systems, an HDMI extender is needed for long cable runs. We currently use Cables To Go TruLink transmitter/recievers.

Manufacturers link: http://www.cablestogo.com/product/29223

Wireless Presenters

- Wireless presenters are commonly used in classrooms to advance PowerPoint slides without having to walk back to the computer. These are not covered under STF funds. Policies for wireless presenters vary by college so please check with local IT providers, chairpersons, or other college leadership before purchasing one since they may require drivers to be installed on classroom PCs. Funding also varies by department but it is usually up to individual faculty to provide their own. OTS does not support these consumer level devices but recognizes they are important in the overall instructional environment.
Wireless presenters are available online and at consumer electronics stores such as Best Buy, Staples, etc.

**Assistive Listening Devices**

*Williams Sound PPA377-Pro*

- This is an RF assistive listening device used to improve hearing ability in spaces with voice amplification.

Manufacturers link: [https://www.williamssound.com/](https://www.williamssound.com/)

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**STF Stickers (CTSG-008)**

A. Sticker must be straight.

B. Stickers must not be in the way of any function, but must be conspicuous to the general observer

C. Items that must be stickered
   1. Projectors
      a. Will be stickered on side facing down if ceiling mounted, must not cover any other labeling or buttons
      b. In future, stickers must be applied prior to mounting for easy access
   2. Document cameras
      a. Sticker must be placed on (WV VZ-3 specific)
         i. On the back of the arm
         ii. On the plate that connects the base to the arm.
            1. Stickers must not be placed on the white base
   3. Computer – computers include class and lab computers as well as iPad’s purchased with STF
      a. Stickers must be placed on
         i. The front
            1. Stickers placed on the front must not cover any buttons or lights
            ii. The top near the TU tag
   4. Processor in rack
      a. Sticker must be placed on the front of the DMPS3-4K-350C - this is to identify the entire rack
   5. Podium, wedge/TPS-6L in particular
      a. Sticker must be placed on
         i. Front base
         ii. Side
         iii. Back
   6. Cameras

D. Stickers must be affixed during QA before photos are taken so they show in the Virtual Tour.

E. After a room is tagged it will be marked as such in COLLECTIONS in the Virtual Tour.
Distance Learning & Lecture Capture

Standard Equipment (CTSG-009)

Towson University has moved to a software based distance learning & lecture capture model. Depending on the room this will either include USB cameras/microphones or a bridge to convert standard camera/microphones to a format that can be connected to the computer in the room.

Cameras must be mounted roughly 7' above finished floor.

Flat panel displays must be mounted 6' above finished floor to the center of the display.

Rooms with multiple flat panels and/or cameras must be labeled using cardinal directions (North, East, South, and West).

Basic Setup

Basic/portable recording can be accomplished in any room with a webcam plugged into the instructor’s PC, TU recommended models can be found here: https://www.towson.edu/technology/facultystaff/hardwaresoftware/hardware.html

A Revo Labs wireless USB mic can be added to this setup for more flexible instructor micing. To capture omnidirectional sound, products are available from Blue and Acoustic Magic to capture the entire room audio.

 Permanent Setup

1) Foundation – This is used to describe the majority of our standard classrooms on campus. These rooms are used for general lectures and would need basic video and mic capabilities to facilitate software-based lecture capture.

   Equipment: Vaddio PTZ USB camera, Vaddio EasyUSB Mixer, and two Vaddio EasyMic Ceiling MicPods. Vaddio Pro Mic I/O can be added if existing non-USB mics need to be integrated. Two displays are also added on the podium to allow for dual monitor functionality.

2) Extended/Curriculized – These are rooms that have needs that go above and beyond what is found in a standard room; this could include the need for more advanced microphones, more camera angles, etc.

   Equipment: Two Vaddio ClearView HD PTZ cameras, Biamp mixer, Vaddio AV Bridge, Clear One ceiling mic arrays, Shure podium mic & lavalier mic (all cameras and mics connect to the computer). Two displays are also added on the podium to allow for dual monitor functionality. Additional equipment to support specific courses or programs of study may be included in Curriculized rooms.

3) Studio: These are rooms that must contain the highest quality video and audio quality possible with consideration given to room lighting, acoustics, etc. They represent the fewest number of classrooms. Special staffing may be necessary to assist faculty or control equipment in a studio environment. Broadcast or near broadcast quality may be typical, as well as other unique types of technology beyond
Distance Learning Equipment in Studio/Curriculized Spaces (CTSG-010)

1. The minimum set of equipment must be installed as follows:
   a. Display 1 in view of instructor
   b. Display 2 in view of students
   c. Camera 1 facing instructor
   d. Camera 2 facing students

* Any display mounted in a classroom must be at least 60” off the floor to the bottom of the display.

2. Each display device must be able to show the following:
   a. Projector: Must be able to show local content (PowerPoint, etc.), camera 1, camera 2, or any content sent from the remote location (remote content, remote camera 1, remote camera 2).
b. Display 1: Must be able to show local content (PowerPoint, etc.), camera 1, camera 2, or any content sent from the remote location (remote content, remote camera 1, remote camera 2).

c. Display 2: Must be able to show local content (PowerPoint, etc.), camera 1, camera 2, or any content sent from the remote location (remote content, remote camera 1, remote camera 2).

3. Standard Scenario

a. Projector: Local content (PowerPoint, etc.) (Must also have the ability to show all media and camera shots)

b. Display 1: Before call is placed shows local Camera 1 as a confidence monitor for instructor to make sure they are in the shot. After call is placed, shows remote camera 2 (students) (Must also have the ability to show all media and camera shots)

c. Display 2: Shows content remote location is sending [remote content, remote camera 2 (students), or remote camera 1 (instructor)] (Must also have the ability to show all media and camera shots)

4. Default Display Configuration (CTSG-012)

If room has 4 displays: One display in back must show remote Camera 2 (remote students) and the other must show local Camera 1 (instructor). One display in front must show remote Camera 2 (remote students) and the other must show local Camera 1 (instructor).
Instructor Stations

Requirements (CTSG-011)

We believe the workstation must not be overpowering in size but large enough to be very functional without feeling cramped. The visible technology must be minimal but utilitarian. Too many lights, annunciators, clocks, switches will intimidate, confuse, and be hard to troubleshoot. Each podium must contain the following:

1. Articulating arms must be used for the monitors (or interactive displays). Model Info: Ergotron 45-241-026
2. Dual Monitors must be installed in any room used for instructional recording.
3. Podium casters must be lockable
4. No doors must be over the keyboard compartment
5. At least one (quiet) fan must be present in the cabinet
6. Grommet positions for whip
7. Core drilling must be used for new buildings, in addition to the conduit for a quad electric outlet and 4 network drops, each floor box must have separate conduit for A/V signal and speaker, mic, camera cabling. 3 1” conduits or 2” and a 1” conduit. Otherwise locking wall plates/receptacles must be used [see Locks (CTSG-016)]
8. In large venues where high power projectors are used, a dedicated circuit must be provided to prevent the projector from shutting down if too much power is drawn.
9. If no core drilling is present, AV cables (whip) must be tightly secured to avoid a tripping hazard. If cables must, as a last resort, be run across floors the ADA compliant LeGrand OFR Series Overfloor Raceway System must be used. Temporarily, yellow tape provided by OTS is acceptable but only if there is a confirmed date when permanent raceway/core drilling will be completed and the use has been approved by OTS.
10. Gooseneck microphones must be present for all Distance Learning rooms and Lecture Halls
11. Four network ports must be run to the instructor stations (1 PC, 1 Laptop, 1 Crestron, 1 Extra). Six for Distance Learning Rooms.
12. Wire diagram must be affixed to the inside of the podium
13. All cables must be labeled
14. Document cameras must have one dry erase overlay at time of install
15. Document cameras must be connected to the podium computer via USB
16. Equipment mounted behind displays and cameras (i.e. power strips, power supplies, USB extenders, DM receivers, etc.) not use velcro to secure it in place. We have had multiple reports of these devices failing down and causing the system to malfunction. Instead we suggest the use of cable ties or other methods that do not use an adhesive that easily breaks down.
17. A/V, computers, and other technology devices are not put on timed circuits or sensors. Power should be available to them 24/7.

18. Assistive listening devices must be installed in all rooms with voice reinforcement.

Cable Cubby (CTSG-012)

The Cable Cubby must include Ethernet, USB, HDMI, 3.5mm audio, RCA, VGA, and two electrical outlets. Laptop connections (VGA & HDMI) must contain pull-through cables with male connectors.
Lighting

Overview (CTSG-013)

A. Obvious, intuitive wall-mounted light switches must be within easy reach of the instructor workstation. They are very reliable, require no training, and will work regardless of the state of the Crestron system.

B. Additional factors: switches must be installed at wheelchair-accessible height; for multiple switches (zoned lighting), the switches must either be labeled or a reference placard must be mounted next to the switch bank; redundant switches must be located on the wall as close as possible to each entry door to the room.
A. Soft Lights directly in front of projection screen must be able to be turned off (including turning off any motion sensor so they do not come back on inadvertently).

B. Lights in the student seating area of the room must be dimmable to allow for low-level illumination (for note-taking) or completely off (for watching videos, etc., where no note-taking is needed).

C. The "master" bank of light switches that control the entire room must be installed on the wall behind or next to the podium for easy access (unobstructed) when lecturing; the instructor must not have to walk more than two steps to manage the lights during the class.

D. At least one light switch must be placed near the entrance of the room. This will let room users turn on at least a portion of the room lights so you can safely enter the room (and turn off the light when leaving).

E. Any occupancy sensors must have the ability to be overridden using the light switches at the instructor podium so the entire room can be darkened or illuminated during a class, under control of the instructor.

F. Light switches must be labeled, ideally with pocket inserts, so the instructor knows what the switch turns on/off. You mustn't have to use trial and error.

G. A motorized screen switch must also be placed near the podium, and labeled. The switch must have up/down/stop (three buttons). Primary control of the screen will be under Crestron touch-panel control, but the manual wall switch must be able to override the Crestron system to allow for manual control.

H. Sight lines – lighting should be flush to the ceiling – or dropped in a way as to not obstruct projector throw to screen.
**Touch Panel**

Screen shots must be submitted to Towson University for review prior to project competition

*Note: We have transitioned to the Crestron TSW-760 panel which eliminates the hard buttons. The options will still be present in the same locations but as “soft” buttons instead.

**Overview (CTSG-015)**

The Crestron TPS-6L combines 12 "hard" switches on the left and right sides of the device with a touch panel "inner core" that allows the programmer to include other interface components: display messages, selection menus, submenus, status indicators, etc. Hard buttons are permanently etched into the control unit bezel; they cannot be changed once the final design is chosen. When a hard button is clicked, the text in the touch panel area describes the functionality ("behavior") that must follow.

Article CTSG-015; Version 1; Last Revised 5/18/2012

**Natural Flow Patterns When Moving Between Controls (CTSG-016)**

A. The user begins the experience with the Start button and works their way through the left panel of hard buttons. The Start button doesn't do much except tell the user what to do next: step through the other buttons on the left-hand panel and turn on the projector, select their audiovisual source, and lower the screen. When class is done, they'd press the Finish to shutdown the system. This kind of natural flow pattern helps guide the movement of a user through a class session.

B. When deciding on what goes on the left-hand panel of hard buttons vs. the right, we followed people's natural reading style for a two-column presentation: you start at the left-most column, read your way from top to bottom, then move on to the next column, doing the same: top to bottom.

C. Secondary controls, menus, and submenus then appear "on demand" in the touch panel based on choices made by pressing a hard button. This follows people's natural skimming style: periphery first (the left and right hard-button panels), followed by the content in the central field (the touch panel).

Article CTSG-016; Version 1; Last Revised 8/27/2015

**Status Bar (CTSG-017)**

The status bar will be always visible at the bottom of the touch panel. It will include the current time of day (12 hour time); current sound level; currently active audiovisual source(s) on the dual-image projector; projector on or off (it won't be obvious if it's in No Show); and annunciators to show whether No Show or No Sound is selected. Since it's a status bar and non-interactive, small but clear icons are acceptable. Example: the sound volume in Windows has a little speaker icon in the System Tray; when muted, there's a red line through the speaker.

Article CTSG-017; Version 1; Last Revised 5/18/2012

**NestingMenus in Layers (Drilldown) (CTSG-018)**

Generally, anything more than one layer deep must be avoided; forcing the user to drill down tends to create confusion in how to get back out. Where possible, a flatter approach is better—provided the interface isn't too cluttered. When a need to nest is believed to be warranted, we will explore other options.
If used, there must be a clearly labeled "Back" or "Cancel" button, and other things would need to be locked out while the submenu is active.

Article CTSG-018; Version 1; Last Revised 5/18/2012

Fonts and Colors (CTSG-019)

A. Colors that carry intuitive meaning for people in other contexts must be used in lieu of trying to showcase the university colors. Examples: for status indicators, red = off/stopped/extreme, green = on/within allowable limits/etc., yellow= borderline/cautionary range. InfoComm provides additional guidance on color usage. It is not absolute, but it is a valuable guide.

B. For multiple button selections with only one permissible choice (e.g., selecting the primary audiovisual source), the button the user selects must appear depressed to be very clear the choice has been made. When one is selected, the non-selected buttons must be raised. Any buttons that are not appropriate for the context or not an allowable option must be grayed out.

C. Flashing text must be used sparingly for imperatives, emphasis, in-transit states, or vital messages.

D. When raising the volume the color must go from green to yellow to red

E. TU Standard Settings:
   a. Font – Arial
   b. Main Titles – 14 Bold
   c. Button Column Titles – 14
   d. Button Text – 11
   e. Other Text – 11
   f. Alias setting: Anti-Aliased

Article CTSG-019; Version 1; Last Revised 5/18/2012

Hard Buttons (CTSG-020)

A. The following hard buttons must be present:
   a. Start – Press to begin using the system, wakes up screen. Must be the only button that can be pressed when at the splash screen.
   b. Project – Press to lower screen and turn on the projector
   c. Source – Displays list of sources to select from
   d. Screen – Displays manual screen controls
   e. Finish – Press to turn system off
   f. Microphones – Press to select whether to use microphones
   g. Volume – Press to change the volume of the system
h. Video Camera (formerly Record) – Press to begin a recording session if the room is equipped with lecture capture or Camera Control Page if room has PC-connected camera.
i. Video Conf. – Press to bring up Video Conferencing Page
j. No Show – Press to temporary stop sending image to projector
k. No Sound – Press to temporarily mute the system. If the system is muted, press to unmute the system. Pressing the volume up or down buttons must also unmute the system.

B. Hard buttons must display a “feature not available” message if not applicable to the room. See “Recording Control Page” for rooms without cameras in Appendix A.

C. Pressing any hard button (or the screen itself) must wake the screen if the touch panel is in sleep mode.

D. For the TSW-760/752/750 Touch Panel, the hard buttons must control the following functions:
   a. Power Button = emulate the START/FINISH buttons
   b. Home Button = Emulate the SOURCE button
   c. Light Button = Title: “Lighting Control Page” Text: “Lighting control is not available in this room”
   d. Arrow Up = Main volume up. Pressing the volume up or down buttons must also unmute the system.
   e. Arrow Down = Main volume down. Pressing the volume up or down buttons must also unmute the system.
Soft Buttons (CTSG-021)

Please see Appendix A

Defaults on System Start (CTSG-022)

No Sound active during system start-up and shut down
Mute microphone (“Don’t Use” position) and MP3 by default
Volume at default level (Approximately 60-65 decibels when measured from the center of the room)
Podium computer must be selected as the source (or laptop if no podium computer)
TV must be tuned to CNN unless stated otherwise

All buttons (Hard and soft) must be locked out during the startup and shut down of the system.

Date and time in lower right hand corner must be in the following format on all pages: July 18, 2012 12:00 (make sure text box is large enough to accommodate September). Time must be synced with the network.

Crestron Touch Panel screen must not go to sleep while system is on

Source Page (CTSG-023)

The Source Page must be laid out like the example below in the exact order pictured. If the podium computer had dual monitors, a “Secondary Monitor” Button must be placed directly below the “Computer” button to allow either image to be shown to any display in the room. There must always be an “Auxiliary HDMI” Button separate from the “Laptop” (VGA) button. All other sources must be hidden unless present in the system. This includes dual display options if dual image is not available. Image Adjust side button must be hidden on digital sources where no adjustments are possible (i.e. HDMI, DVI, other fully digital sources). Fully digital systems (i.e. Crestron DMPS3-4K-350-C) will not have image adjust options available on any source. Left and right image source list must mirror each other (button must be blacked out on opposite source list when selected). On rooms with single source display, “Clear” button must be removed.

Left and right image must be stage left and stage right, meaning the instructor’s left and right while facing the students. (http://plays.about.com/od/basics/ss/stageright.htm)
Security

Locks (CTSG-024)

1. Compartment with A/V rack must lock separately from CPU compartment
2. CPU compartment must not be lockable (unless absolutely needed to be secured)
3. A/V rack lock must be a non-electronic combo lock (no-batteries)
4. Core drilling must be used for new buildings, otherwise locking wall plates/receptacles must be used
   - OTS has identified the following model to use with A/V wall plates that contain DM, Control, and Speaker cable connections:
   - The wall box must be labeled “Specialty Ports Do Not Disconnect”

<table>
<thead>
<tr>
<th>SKU</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>AI-DBP2</td>
<td>Arlington Industries Medium-Sized, Vertical Mount Dri-Box Adapter w/ Non-Metallic Dual Gang Base- White</td>
</tr>
</tbody>
</table>
• Red Crestron network cables must be secured to the networking wall ports using this model of lock:

<table>
<thead>
<tr>
<th>SKU</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAN-PSL-DCPL-RD</td>
<td>Panduit-&quot;Package of 10&quot; Flush Mount RJ45 Plug Lock-in Devices and One Installation/Removal Tool</td>
</tr>
</tbody>
</table>

Sonic Shock (CTSG-025)

A. Sonic Shock alarms must be attached to the following equipment items, unless otherwise specified in a statement of work: projectors, large screen displays, and all podium equipment (document cameras, media players, Crestron processors).

B. The Sonic Shock must be mounted in document camera drawer.

C. DVD/Blu-ray need not be alarmed IF it is rack mounted with security screws.

D. Sonic Shocks must be attached to SMART podiums and all-in-one PCs/Macs.

E. If there is a reason to locate the Sonic Shock elsewhere (e.g. not in the drawer), an exception must be requested through the Instructional Services Engineer.

F. Sonic Shock Stickers must be affixed to projector.

G. Sonic Shock keys must all be keyed to the TU master.

H. BULLETIN 14-1: Regarding Sonic Shock Inclusion for VSI Installations and Replacements

Issued by Michael Bachman 7/30/2013

Background

There has been confusion on when and if Sonic Shock alarm units are to be included in installations. This usually comes into play when TU staff inspect work at the conclusion of a job. This bulletin must clarify the Sonic Shock expectations for both VSI and TU.

Pertinent Contract Language

1. The terms and conditions of the On-Call Contract call for the following in the Security section:
   A. One or more Secure-It Sonic Shock SSA-100 unites shall be used to secure the following components in the instruction workstation: computer, monitor(s), visual presenter, Extron or
Crestron controller, and Blu-ray/DVD player

2. One or more Secure-It Sonic Shock SSA-100 units shall be used to secure the projector(s), audience flat panel, and other major pieces of equipment not permanently housed in the instructor workstation.

Intention

The intention of the language in the contract, as I wrote it, was that it would apply primarily to these types of jobs:

1. Installation of a new complete system
2. Substantial renewal of an existing system, such as refresh of the AV core
3. New or replacement installations of individual pieces of equipment which would normally be equipped with a Sonic Shock as defined in Security sections A and B.

Example Scenarios

1. TU requests a new classroom system to be designed and installed in a classroom that has no existing system. A Sonic Shock would be expected to be provided in accordance with contract terms in Security, Sections A and B.
2. TU requests a projector replacement; the projector is obsolete and a newer model is desired. A Sonic Shock would be expected to be provided in accordance with contract terms in Security, Section B. The work requested is directly tied to a piece of equipment that requires a Sonic Shock.
3. TU requests a projector replacement as above; when the room is inspected, the TU staff member notices a missing Sonic Shock alarm on another piece of equipment which would be normally alarmed, such as a document camera. A Sonic Shock would still expected for the projector; however, TU would not expect contractor to provide or install a Sonic Shock for the document camera.
4. Visual Sound’s sole due-diligence expectation would be to report the omission with the document camera if the installer happened to notice it in the course of the projector work; to be clear, a formal inspection of the room is not expected in this case to determine whether all equipment specified in the On-Call Contract has Sonic Shock alarm(s). That is the duty and responsibility of TU staff in this case—except for the projector.

Basis of Interpretation

1. The contract terms and conditions supersede all other interpretations. We expect that products, services, and standards stated in the contract will be applied, whether explicitly quoted or not, to all jobs under the contract.
2. Variances between the contract terms and conditions and TU’s published standards must be worked out and addressed prior to issuance of a quote.
3. If TU or VSI waives something in the preliminary discussions leading up to a quote, it must be specified in the SOW as part of the quote submission. This will prevent surprises and misunderstandings for both parties.
4. Although TUs published standards provide additional guidance, if there is a collision between the standards and the contract, the contract prevails absent prior agreement.
5. The director is the sole person who will interpret the contract within the OTS Classroom and Computer Lab Technologies group.
6. If Visual Sound feels the interpretation is incorrect, the appeal path is TU Procurement.

Additional Notes
1. Since the contract’s inception, TU has waived the requirement for Sonic-Shock devices on the Crestron controller (touch panels), and the Blu-ray/DVD player, provided the player is secured in a rack with security screws or otherwise protected in a manner that TU would agree to.

2. TU has rescinded the engraving requirement. The potential damage to equipment and the difficulties it creates in executing warranty returns and replacements outweighed the potential security benefits.

3. TU will publish a bulletin to contractors whenever our published standards change in a substantive way.

4. Bulletins will not be issued for minor things such as correction of typos or grammatical errors, unless they are substantive (e.g., touch panel verbiage) and could affect contractor work or services.

Classroom (CTSG-026)

A. Swipe Locks must be installed on main classroom entrance

B. All keys (i.e. podium) must be turned over to Manager of Classroom Technology.

C. All equipment must be engraved with “Towson University”

D. It is recommended that classrooms that feature computer labs have an alarm code for access.

A/V Rack (CTSG-027)

A. Use security screws to rack-mount equipment

B. Racks that are outside of podiums must have their own keyed locks

C. All rack equipment that is capable of having a password must have one (Crestron controllers, routers, etc.)

Networking

Crestron Network Cables (CTSG-028)

All Crestron processors must be connected to network ports using RED network cables. This will help quickly identify which cable runs to the Crestron for installation and troubleshooting purposes.
Information Needed (CTSG-029)

A. Please see Crestron Worksheet for information needed to add Crestron equipment on the TU Network: Crestron Worksheet

B. Once a port is configured the red Crestron network cable must remain plugged into the same port and port must be labeled with a “C”.

C. All Crestron processors must have the following DNS servers entered in settings: 10.20.1.5 and 10.20.1.6

Routers/Switches (CTSG-030)

A. Any switches being used in the podium must first be approved by Towson University’s network group.

B. Items such as computers and Crestron equipment cannot be plugged into the same switch since they use different VLANs. Only one VLAN can be assigned to a switch/router so all devices must match this VLAN.

C. Red network cables must be used to connect the router/switch to the wall port if a Crestron device is connected to the router/switch.

D. Routers/Switches must not be plugged into any other port besides the one that was specifically configured for it or it could pose a security threat to the TU network.

VLAN (CTSG-031)

A. All Crestron processors must be on VLAN 541

B. All video conference equipment (i.e. Cisco C40) must be on VLAN 540

Wall Ports (CTSG-032)

A. All Network ports must be installed with non-user accessible wall plates so that cables cannot be unplugged

B. All DM cables that have RJ-45 style connectors must also have non-user accessible wall plates so that cables cannot be unplugged
Crestron Fusion RV (CTSG-033)

A. All Crestron systems must be connected to Crestron Fusion RV

B. All Crestron systems must have an Xpanel loaded on the Crestron Fusion RV server

C. All Crestron systems must have the “device usage” model loaded to report on all sources and “dual image” functionality.

Crestron Code (CTSG-034)

A. The latest version of the un-compiled Crestron processor and touch panel code must be uploaded to the Crestron code share (\customshare\cclt$) every time a change to the system is made following the guidelines outlined in the instruction document located on the share.

B. A wiring diagram must be uploaded to the Crestron code share (\customshare\cclt$) every time a change to the system is made.

C. All serial numbers must be uploaded to the Serial Number SharePoint site:
   https://tu.sharepoint.com/sites/cclt/Lists/Towson%20University%20Serial%20Number%20Spreadsheet/AllItems.aspx

Appendix A

Crestron Touch Panel: Soft Buttons TSW-760/750/752 (CTSG-035)

TSW-760/750/752 Panels must generally follow the same guidelines as the TPS-6L below

Splash Screen
Help Screen

Please call (410) 704-8324 (4TECH) for assistance with the audiovisual system.

If button other than “START” is pressed
Welcome screen

Press START to begin using the audiovisual system.

Projector Status

Press PROJECT to start the Projector.

When you are done with your class or presentation, press FINISH to shut down the audiovisual system.

No Sound Active   March 14, 2016 9:50 AM
Projector Status

Projector is warming up

Please be patient

This will take 30 to 40 seconds. All other controls are locked during the warm-up period.

<table>
<thead>
<tr>
<th>Source Select Page</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Source Select Page</strong></td>
</tr>
<tr>
<td>Left or Single Image</td>
</tr>
<tr>
<td>Computer Primary</td>
</tr>
<tr>
<td>Computer Secondary</td>
</tr>
<tr>
<td>Laptop</td>
</tr>
<tr>
<td>Document Camera</td>
</tr>
<tr>
<td>Auxiliary</td>
</tr>
<tr>
<td>Auxiliary HDMI</td>
</tr>
<tr>
<td>Air Media</td>
</tr>
</tbody>
</table>

March 14, 2016 9:54 AM

Control fly out
Source Select page for rooms with two displays (i.e. projector and LCD). “Computer Secondary” enables extended desktop so windows can move from one screen to another (i.e. dual monitors).

Display Select Page (appears when pressing START>PROJECT or “Display Select” on the source page)
Document Camera controls

Display Select Page

Please select a display target:

- Left Monitor
- Right Monitor
- Both

Document Camera Control Page

Lamp

- On
- Off

Zoom

- In
- Out

Focus

- Auto Focus
- +
- -

March 14, 2016 9:55 AM

Screen Control page
Touch Panel Cleaning page

Touch Panel Status

Time Remaining

Controls on the panel are now suspended so you can clean it with a soft, dry cloth

Microphones page
Microphones page in room without mics

Volume page
Advanced Volume Control page

Advanced Volume Control page in room with microphones
Video Camera (formerly Record) Page

Video Camera (formerly Record) page in room without camera
Cameras are not available in this room.
If no selection is made the system will shutdown in **00:42**
Are you finished using the audiovisual control system?

If you select "Yes" it will take approximately two minutes before the audiovisual control system can be restarted.

March 14, 2016 12:19 PM

Projector Cooling Down

System is powering off

The audiovisual system is powering off...please wait

Please make sure you logoff from the computer and secure the room
System Offline

The audiovisual control system is offline. Please call (410) 704-8324 (4TECH) for assistance.

For rooms that require an “Audio Only” Option
Press START to begin using the audiovisual system

Welcome

Press PROJECT to start the video projector

Select "AUDIO ONLY" if you don't need the projector

When you are done with your class or presentation, press FINISH to shut down the audiovisual system

No Sound

No Show

Active

Active

October 30, 2014 10:56 AM
Apple TV Source button
Apple TV Controls

DVD Control Page
Crestron Touch Panel: Soft Buttons TPS-6L (CTSG-036)

Splash Screen

This screen must appear if a hard button other than START is pressed. The extra arrow must disappear 10 seconds later if no further action is taken.
Start  (If the START button is pressed and the user does not press PROJECT to continue with startup it must return to the splash screen in 30 seconds.)
Projector Power on (Status bar must be adjusted to go as quickly as possible on a projector by projector basis depending on startup time)
Projector already on page
Source Select Page (Digital sources will not have “image adjust” sub-pages). Note: The “Optional/Dual Image” column must list all sources on systems that use a TV One dual image processor. The screen shot below was taken from a system using the dual image function built into the projector.
Screen Control Page (Must not be available if no electric screen)

Buttons must turn green when depressed for feedback. All must return to their normal white color when not being pressed.
Image Adjust (Analog systems only)
Volume (when raising the volume the color must go from green to yellow to red). Pressing the volume up or down buttons must also unmute the system.
Advanced Volume (when raising the volume the color must go from green to yellow to red). Pressing the volume up or down buttons must also unmute the system.
Podium Microphone (If no Microphones are installed, page must read: "Microphones are not available in this room". If non-controllable microphones are installed, page must read "Microphone control is not available in this room")
Wireless Microphone (must add third set of identical buttons titled “Handheld Microphone” if one is present in the room)
Video Camera (formerly Record) (if no camera present)
Recording Control Page

Recording is not available in this room.

Record Password (see Instructional Services Engineer for code)
Enter Passcode

Please enter a valid password to gain access to the recording controls

Record (For Mediasite only)  Note: Titles must be bold to match DVD control page
Record (For Cisco Only)
Camera Control Page (preview of video must appear behind camera controls)
Stop Recording (For Mediasite Only)
Confirm Stop for Mediasite Recording

Do you really want to stop Mediasite recording?

Yes  No

Warning: Pressing "Yes" will completely end this session and the presentation will be saved. You will not be able to resume recording. If you just want to pause, press "No" instead.

Stop Recording (For other solutions)
*A rotate button must be added to accommodate using the document camera as a student facing camera.
DVD/Blu-ray Control Page
DVD/Blu-ray Advanced Control Page
Help

The Help button must display the following text:

Please call (410) 704-8324 (4TECH) for Assistance with the audiovisual system.
Please call (410) 704-8324 (4TECH) for assistance with the audiovisual system.
TV Full Screen
TV Presets
Video Conference (For Polycom Only)
VTC Camera Controls

Video Conference (For Cisco Only)
Monitor Control Tab
Finish (Note: “Yes” must automatically be selected after 1 minute of inactivity)
Goodbye (Status bar must be adjusted on a projector by projector basis and go as quickly as safely possible)
Appendix B
Crestron Push-Button Systems: Hard Buttons (CTSG-037)

A. Types of Crestron push-button systems
   a. MP-M series require a separate MPS system:
      MP-B10
      MP-B20
   b. MPC-M series do not require a separate MPS system:
      MPC-M10
      MPC-M20
   c. The 10 series has 10 select buttons, two rows
   d. The 20 series has 15 select buttons on three rows and 5 navigational buttons

B. Color of panel
   a. The Crestron push-button systems are available in black or white.
   b. The black system must be used in all cases unless otherwise specified by TU
   c. The body, faceplate and mount must all be of the same color

C. Color of inserts
   a. On black push-buttons the printed inserts must be black with white lettering
   b. On white push-buttons the printed inserts must be white with black lettering
   c. On any buttons not used the insert must be filled with a blank that matches the color of the faceplate
D. Style of inserts
   a. The lettering on the inserts must be in all caps and be centered on space
   b. Two lines may be used but only if required by the length of text

E. Screws on faceplate
   a. The screws on the push-button faceplate must be the screws designed for the system and must match in color

F. Which panel to use
   a. The Crestron MP-B20 is the standard that must be used for most installations
   b. The MPC-M20 must only be used when it is not feasible to also install a MPS
   c. MPC-M10, or MP-B10 must only be used in Tier 1 installations where there is only a wall port and no DVD/VCR to be controlled

G. Standard buttons
   First Row
   a. SYSTEM ON/OFF – Turns the system and projector on and defaults to PC as the main source, press again to turn system and projector off. If system is equipped with an electric screen this button must also raise and lower it.
   b. AUX – Switches to the analog composite video source
   c. AUTO IMAGE – Automatically adjusts image on analog sources must be turned into an HDMI source button on digital systems
   d. No Sound – Press to temporarily mute the system. Pressing the volume up or down buttons must also unmute the system.
   e. No Show – Press to temporary stop sending image to projector

   Second Row
   f. PC – Switches to the computer source
   g. DOC CAMERA – Switches to the document camera
   h. LAPTOP – Switches to the laptop connection
   i. DVD – Switches to the DVD player
   j. VCR – Switches to the VCR

   Third Row
   k. Play symbol – Press to start playing a DVD or VHS tape, press again to stop
   l. Pause symbol – Press to pause a DVD or VHS tape
   m. Rewind symbol – Press to skip rewind VHS tape or skip backwards on a DVD
   n. Fast Forward symbol – Press to skip forward on a VHS tape or DVD
   o. MENU – Brings up the DVD menu
   p. Directional buttons control DVD navigation functions

Article CTSG-037; Version 1; Last Revised 5/21/2012
Appendix C

Podium Drawings (CTSG-038)
Credenza Drawings (CTSG-039)

MPRC28
42" w X 30" h X 23" d Rack credenza
(2) sets of RRF-14 rack rails
color: wa fusion maple 7909-60 w/matching 3mm pvc
qty: 3

Appendix C

Non-Standard Rooms (CTSG-040)

Towson City Center 209:

Primary image duplicated on 2nd projector.

Dual image button will project secondary image on other projection screen

Small display on monitor on podium shows instructor camera

Rear display mirrors primary source
Rear display shows distance learning location during video conference.

Article CTSG-040; Version 1; Last Revised 5/21/2012

Lecture Capture Scenario for Cisco Codecs (CTSG-041)

1. The "Record" hard button will be pressed on the touch panel

2. Client will be prompted for a pass code

3. A screen with a Qwerty keyboard will come up asking the client to "Enter your NetID to start recording:" (the crestron will need to be programmed to add "@video.towson.edu" to the end of whatever is typed). Paul will follow up with exact command. The command for number 3 will be "xCommand Dial Number:netid@video.towson.edu Protocol:Sip CallRate:4000<LF>" where netid will replace by keyboard entry.

4. A back button must be present to go back to keyboard screen if something is miss typed.

5. A stop recording button must be available to hang up the call. There must be a confirm dialog box before actually stopping the recording. The confirmation must use the general design of the message presented to the user when they press Finish to shut down the system. Use “Are you sure you want to stop recording?” for the verbiage and include Yes/No buttons, as with the Finish confirmation.

Article CTSG-041; Version 1; Last Revised 6/12/2014
Tracking Log

11/09/2018 – Updated all instances of DMPS3-4K-300-C to DMPS3-4K-350-C
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1 OVERVIEW

1.1 Purpose

1.1.1 This document describes Towson University’s IT infrastructure standards for its cable plant and its data, telephone, and television network.

1.1.2 This standard references a set of industry standards to which the University’s IT infrastructure must conform and supplements them with University-specific requirements.

1.1.3 The University provides this document to consultants developing construction documents, bidders bidding on cabling projects, and contractors performing cabling work.

1.1.4 For a consultant developing construction documents, it provides the information required to design an IT infrastructure that is consistent with Towson University’s IT infrastructure standards and to integrate that design into construction documents.

1.1.5 For a bidder bidding on a University cabling project that contains or references this document, it defines acceptable materials, execution requirements, and other information required to develop a bid.

1.1.6 For a contractor executing cabling work, it provides instructions and requirements for performing the work.

1.2 Organization

1.2.1 This document is divided into four parts:

a) Overview

b) Design standards

c) Parts & Materials

d) Execution

1.2.2 Each part is organized into sections and subsections.

1.2.3 Each provision of the standard has a unique identifier to make them easy to reference.

1.3 Guidance for Consultants

1.3.1 This section contains guidance for consultants developing construction documents.

1.3.2 A consultant must understand this document thoroughly.

1.3.3 The design specifications section provides the high-level information a consultant needs to design the IT infrastructure.

1.3.4 Parts & Materials
1.3.4.1 This document specifies parts and materials by:

a) Performance characteristics.

b) Specific manufacturer and part number.

1.3.4.2 Parts and materials specified by performance characteristics can be any part by any manufacturer that meets or exceeds the specified performance characteristics except for manufacturers or part numbers expressly prohibited by this document.

1.3.4.3 Parts and materials specified by manufacturer and part number are specific parts that must be used.

1.3.5 Telecommunication Rooms

1.3.5.1 This document goes to great length to specify the bare minimum requirements for Telecommunication rooms. Therefore, they must meet the requirements in this document must be met. There is no room for flexibility.

1.3.5.2 The most common problem and source of frustration for all parties during the development of construction documents is improperly located and sized telecommunications rooms.

1.3.5.3 To ensure telecommunication rooms are properly located and sized, the consultant must:

a) Ensure telecommunication room requirements are included in the conceptual design document along with programming for all other parts of the building, with worst-case square footage and specific requirements for their location.

b) Ensure that telecommunication room requirements are included in all submissions of the design development documents, that the telecommunication rooms are clearly shown on drawings, and that their size and location meets requirements.

c) Ensure that telecommunication room requirements are met in all submissions during the construction document development.

1.3.6 Frequently Missed Items

1.3.6.1 Equipment racks, wire management, patch panels, faceplates, and jacks are all specified by manufacturer and part number are frequently missed.

1.3.6.2 The requirement for penetrations through fire rated structures, particularly the cable count threshold for the use of conduit with fire stopping vs EZ-Path fire barriers, is frequently missed.

1.3.6.3 The color-coding for category 6 and 6A UTP is frequently missed.

1.3.6.4 The color-coding and specific part numbers for category 6 and 6A jacks is frequently missed.
1.4 Scope Conflicts

1.4.1 This section pertains to projects where the University provides this document to a bidder as part of a bid package, or references it in a bid package.

1.4.2 Bidders must bring conflicts between the scope of work and this document to the University’s attention for clarification.

1.4.3 If a bidder fails to bring such conflicts to the University for clarification, this document takes precedence unless the scope of work explicitly states it overrides this document.

1.5 Construction Document Conflicts

1.5.1 This section pertains to projects where a design consultant integrates these standards into construction documents used for bid.

1.5.2 The design consultant is solely responsible for integrating these requirements into the construction documents.

1.5.3 The University’s review of construction document submissions in no way relieves the design consultant of his responsibility to integrate these requirements into the construction document.

1.5.4 The design consultant must bring conflicts between this document and the construction documents to the University’s attention for clarification.

1.5.5 If the design consultant fails to bring such conflicts to the University’s attention, this document takes precedence.

1.6 Quality Assurance

1.6.1 The contractor must perform work in accordance with the BISCI Methods Manual.

1.6.2 The contractor must perform work in accordance with the EIA/TIA Building Telecommunications Wiring Standards.

1.6.3 The bidder is responsible for bringing conflicts between this document and the BICSI or EIA/TIA standards to the University for clarification.

1.6.4 If the bidder fails to bring such conflicts to the University for clarification, the more stringent standard applies.

1.7 Submittals

1.7.1 If site conditions prohibit installation as shown on the drawings, the installer must submit the required changes to Towson University for approval prior to installation.

1.7.2 The contractor must submit cut sheets for each part or material required for the project that this document specifies by performance characteristics for the University’s review and approval prior to ordering.

1.7.3 The contractor must submit all installation procedures that deviate from the manufacturer’s installation procedures to the University for review and approval prior to ordering.
1.8 Documents

1.8.1 The contractor must accurately record the location of service entrance conduit, termination backboards, outlet boxes, port locations and labeling, cable raceways and basket trays, pull boxes, and equipment boxes on detailed floor plans.

1.8.2 The contractor must document the cable plant and associated equipment in accordance with the specifications detailed below.

1.8.3 The contractor must provide test results in Microsoft Excel format for all cables installed.

1.9 Applicable Standards

1.9.1 The University has adopted the standards included in this section and has referenced them rather than repeat them in this document.

1.9.2 In the event of a conflict between these standards, or between these standards and this document, the more stringent standard applies.

1.9.3 TIA/EIA Standard 569 – Commercial Building Standard for Telecommunications Pathways and Spaces

1.9.4 TIA/EIA Standard 568B – Commercial Building Telecommunications Wiring Standard

1.9.5 TIA/EIA Standard 606A – Administration Standard for Telecommunications Infrastructure of Commercial Buildings

1.9.6 TIA/EIA Standard 607 – Commercial Building Grounding and Bonding Requirements for Telecommunications

1.9.7 National Electric Code


2 DESIGN STANDARDS

This section describes the standards a design consultant needs to develop an IT infrastructure that is consistent with the University’s IT infrastructure standards and incorporate that design into construction documents suitable for bid.

2.1 Conventions

2.1.1 Throughout this section, the following phrases have the meanings defined here.

2.1.2 The phrase “the consultant must specify” indicates that the consultant must include the information that follows in the construction documents.

2.1.3 The phrase “point of penetration” indicates the point where the outside plant cable emerges into the building, through either an exterior wall or the basement slab, as defined in the NEC.

2.1.4 “Construction documents” refers to all drawings and narrative text a consultant develops for bid.

2.2 Outside Plant Cable

2.2.1 OSP cable consists of single-mode and copper cable.

2.2.2 OSP coaxial cable is not required.

2.2.3 The consultant must consult the Office of Technology Services for the types and counts of OSP cable.

2.2.4 The consultant must specify OSP cable consistent with the performance characteristics for OSP cable provided in the Parts & Materials section of this document.

2.3 Riser Cable

2.3.1 Riser cable consists of single mode fiber optic cable, copper cable, and coaxial cable.

2.3.2 The consultant must specify 24 single mode fiber optic cables from the MDF to each IDF.

2.3.3 The consultant must specify a 25-pair copper cable from the MDF to each IDF.

2.3.4 The consultant must specify one RG6 coaxial cable from the MDF to each IDF.

2.3.5 The consultant must specify riser cable that is consistent with the performance characteristics for riser cable provided in the Parts & Materials section of this document.

2.4 End-Station Cable

2.4.1 End-station cables are Category 6 UTP, Category 6A UTP, and RG11 coaxial cable, that extends from a MDF or IDF to an end-station.
2.4.2 Cable for data must be orange Category 6 UTP. Installers must terminate data cable with an orange Category 6 jack at the end-station and at the patch panel in the TR.

2.4.3 Cable for analog voice must be grey Category 6 UTP. Installers must terminate analog voice cable with a black Category 6 jack at the end-station and on a 110-punch block in the TR.

2.4.4 Cable for wireless access points must be yellow Category 6A UTP. The installer must terminate wireless access point cable with an RJ-45 at the wireless access point location and on a yellow Category 6A jack at the patch panel in the TR. The installer must provide a 15’ service loop at the wireless access point location.

2.4.5 Cable for surveillance cameras must be green Category 6A UTP. The consultant must specify that the installer must terminate surveillance camera cable with an RJ-45 at the surveillance camera location and a green Category 6 jack at the patch panel in the TR. The installer must provide a 15’ service loop at the wireless access point location.

2.4.6 The consultant must specify the performance characteristics for end-station cable and terminators provided in the Parts & Materials section of this document.

2.4.7 A standard communication outlet for an office consists of two data jacks.

2.4.8 Each office space must have exactly one standard communications outlet for each desk. Any deviation from this standard must be approved by the University’s Office of Technology Services.

2.4.9 The consultant must offset Communication outlets on adjoining walls such that they are not exactly back-to-back.

2.5 Cable Pathways & Supports

2.5.1 This section describes interior cable pathways and supports.

2.5.2 Cable in all TR’s must be supported by ladder rack.

2.5.3 Cable in all major corridors must be supported by basket tray.

2.5.4 Cable in minor corridors must be supported by j-hooks.

2.5.5 There must be 12 inches of clearance above and to one side of all cable supports.

2.5.6 The consultant must specify cable supports sufficient to satisfy the initial capacity for the project plus a reasonable margin for growth given the potential use of the space it serves.

2.5.7 Installers must not attach cable supports to anything other than the building structure.

2.5.8 Installers must not attach anything to telecommunications cable supports.

Installers must not install anything other than telecommunications cable or low voltage cable specifically approved by the Office of Technology Services in telecommunications cable supports.

2.5.9 Penetrations through fire-rated walls intended to support 8 or fewer cables must use conduit with fire-stopping putty.

2.5.10 Penetrations through fire-rated walls intended to support more than eight cables must
use EZ-Path fire barriers.

2.5.11 Penetrations through non-fire-rated walls must be conduits or sleeves.

2.5.12 Vertical chases outside of a TR must have:
   a) Access panels on each floor.
   b) Plywood on each interior wall.

2.5.13 The consultant must include 4 4-inch sleeved core holes inside each stacked TR’s to create an open vertical chase within the stack of TR’s.

2.6 Conduits & Fire Stopping

2.6.1 Conduit sleeves must be four (4) inch trade size minimum with a minimum of three (3) sleeves to connect the TC’s vertically.

2.6.2 Sleeves must be Rigid Galvanized Steel for penetrations of concrete slabs, concrete walls, and CMU walls.

2.6.3 Sleeves for penetrations of stud walls must be EMT.

2.6.4 All sleeves must be rigidly installed using appropriate fittings and all masonry penetrations must be grouted.

2.6.5 Sleeves must project a minimum of six (6) inches beyond wall or floor surface.

2.6.6 All penetrations of fire rated construction must be fire stopped with fire stopping as specified earlier or exceed fire rating of the penetrated material.

2.6.7 Sleeves for penetration of walls and floors must have one hundred percent (100%) spare capacity, and must be fire stopped as per code.

2.6.8 Any section of conduit containing two (2) 90-degree bends, a reverse bend, of having length greater that one hundred (100) feet must have an accessible pull box.

2.6.9 All conduits must have a 3/32-inch polyethylene pull cord appropriately secured at each end and replaced if used.

2.6.10 No oval or square conduit fittings must be permitted.

2.6.11 No screw type fittings must be permitted.

2.6.12 All metallic conduit and raceways must be appropriately grounded as specified in the National Electric Code.

2.6.13 An AWG #6 ground wire will be installed in both vertical risers from the basement to the top floor.

2.6.14 This ground must be attached to the building’s approved grounding point used for the building electrical service at one (1) point only.

2.6.15 A ground bus must be provided in each TC bonded to the communications ground system.

2.6.16 Each floor will be equipped with a center hung cable tray as Manufactured by OBO
Bettermann or equivalent from the telecommunications closet, above the suspended ceiling in corridors, to provide an access path to each communications outlet.

2.6.17 Three (3) 4” electrical metallic tubing (EMT) conduits will be installed to provide access to the center hung cable tray from the telecommunications closet.

2.6.18 The center hung cable tray must be installed as low as possible above the suspended ceiling and secured according to the National Electric Code.

2.6.19 If possible, at least 18” clearance above the center hung cable tray.

2.6.20 The telecommunications center hung cable tray should be on the opposite side of the ceiling space from cable ladder racks or other distribution used for electrical service.

2.6.21 Where possible, all 90-degree turns should be made by two (2) 45-degree turns.

2.6.22 Supports and fasteners must be used such that they provide an adequate safety factor.

2.6.23 All conduit/cable trays must be supported from the building structure and not from any other ductwork, pipes, ceiling tiles, or equipment.

2.6.24 All conduits should be a maximum of two (2) inches from any finished plywood wall.

2.6.25 Should ceiling space not allow for cable tray, contractor must install J-hooks, adequate for Category 6 cable, with a span of no greater than 4’ from hanger to hanger.

2.6.26 Where cable tray or conduit is not provided, J-hooks adequate for Category 6 cable must be installed.

2.6.27 The J-hooks must be attachable to a floor slab through the use of a pre-threaded lead insert which is suitable for installation of a 3/8 inch “all-thread” rod in a predrilled 1/2 inch hole.

2.6.28 The threads of the closure bolt on the pipe hanger must be covered by 3/8-inch copper or aluminum tubing to protect the cabling sheaths.

2.6.29 Cables placed in hangers in the plenum ceiling area must be routed high and away from all other electrical and mechanical systems so as to avoid contact with light fixtures, ventilation ducts, sprinkler systems or plumbing piping, motors, or any other electrical devices.

2.6.30 The cable must not be run in parallel with any high voltage electrical wiring.

2.6.31 The maximum separation between support points for all cabling must be four (4) feet.

2.6.32 Lay in pipe hangers must be installed so as to accommodate maximum distance spacing.

2.6.33 Hangers must be installed at directional bend points so as to provide a maximum bend angle of 45 degrees for the supported cabling.

2.6.34 Contractor must install 3/32 inch O.D., 200lb. Strength, polyethylene pulling string in each empty conduit, and appropriately secured at each end.
2.7 Telecommunication Rooms

2.7.1 Locations

2.7.1.1 The consultant must specify a single MDF on the lowest floor.

2.7.1.2 The consultant must specify one or more IDF's as necessary given the layout of the building.

2.7.1.3 The consultant must vertically stack all TR's centrally in the building.

2.7.1.4 If the building is too wide to allow for a single stack that provides coverage for the entire building, the consultant must design multiple vertical stacks of TR's.

2.7.1.5 The consultant must minimize the number of TR's by serving multiple floors from a single TR where possible.

2.7.1.6 The consultant must locate TR's such that telecommunications cable can reach every point in the building with cables no longer than 90 meters run through the designed cable pathways.

2.7.1.7 If the MDF is located more than 50 feet from the point of penetration, the consultant must specify that each OSP conduit must extend to the MDF through RMT, as required by the NEC.

2.7.1.8 The consultant must design the dimensions of the hub rooms based on an estimate of each TR's capacity and the TR clearance requirements included in this document.

2.7.1.9 The consultant must specify all of these requirements in writing during the conceptual design phase.

2.7.1.10 The consultant must specify these requirements in writing during design development.

2.7.1.11 The consultant must specify each TR during construction document development.

2.7.2 Dimensions

2.7.2.1 The consultant must ensure that the dimensions of each TR conforms to the specifications in this section.

2.7.2.2 The number of racks required for a TR and the clearance requirements for those racks constrain the possible dimensions.

2.7.2.3 The capacity of a TR determines the required number of racks.
2.7.2.4 The initial number of data drops in a TR plus its potential for growth over the lifetime of the TR is the TR’s capacity.

2.7.2.5 The consultant must determine the initial number of data drops for each TR.

2.7.2.6 The consultant must use the following table to determine the number of racks for each TR.

<table>
<thead>
<tr>
<th>Initial Capacity</th>
<th>Growth Potential</th>
<th>Capacity</th>
<th># of Racks</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;= 192</td>
<td>192</td>
<td>384</td>
<td>1</td>
</tr>
<tr>
<td>&lt;= 384</td>
<td>384</td>
<td>768</td>
<td>2</td>
</tr>
<tr>
<td>&lt;= 576</td>
<td>576</td>
<td>1,152</td>
<td>3</td>
</tr>
<tr>
<td>&lt;= 768</td>
<td>768</td>
<td>1,536</td>
<td>4</td>
</tr>
</tbody>
</table>

2.7.2.7 The consultant must use 100% as the growth potential for a TR, as described in 2.7.6, unless the consultant can demonstrate that an increase or decrease is justified and the University approves the adjustment in writing.

2.7.2.8 The consultant must assume the footprint for all racks is 3 feet wide by 3 feet 6 inches deep, which includes vertical wire management on both sides of the rack.

2.7.2.9 The consultant must assume that side-by-side racks have their own vertical wire management on both sides and do not rack a common vertical wire manager. For clarity, side-by-side racks have the footprints shown in the following diagrams.

2.7.2.10 The consultant must estimate the capacity of each TR as its initial capacity plus an estimate of its potential for growth over the lifetime of the TR.

2.7.2.11 All racks must have a minimum 3 feet of clearance on the front, back, and one side.

2.7.2.12 The interior racks within a row of racks only require 3 feet of clearance in the front and back.

2.7.2.13 The 3 feet of clearance between racks placed one in front of the other, as would be the case for a narrow room, satisfies the clearance requirement for the back of the front rack and the front of the rear rack as illustrated in the following diagram.
2.7.2.14 If the room contains interior corners, columns, or other obstructions, the clearances apply to those features as well as the walls.

2.7.2.15 The clearance between a wall and a rack must take wall-mounted equipment into account. If wall mounted equipment such as 110 blocks, electrical circuits, etc., protrude 4” from the wall, the clearance between the rack and the wall must be 3’4”.

2.7.2.16 Electrical circuits mounted on racks are included the specified rack footprints.

2.7.2.17 Within these constraints, and the spirit of these constraints, the consultant must configure the room in any size and shape. However, to illustrate the intent, the following diagrams are examples of acceptable rack configurations and room dimensions.

2.7.2.18 The consultant must decide upon the dimensions of each TR in conjunction with the architect and document them at each submission during conceptual design, design development, and construction document development.

2.7.3 Electrical Requirements
2.7.3.1 All circuits must be dedicated.

2.7.3.2 There must be one duplex 15A, 120V circuit with 15-R receptacles placed on the wall to the left or right of the hub room’s entrance.

2.7.3.3 There must be one quad 15A, 120V, circuit, with 15-R receptacles placed on the back of the right-most rack if racks are in a row or the rear-most rack if racks are one in front of the other.

2.7.3.4 There must be two 20A, 220V, circuits, with a L6-20R receptacle placed on the back of every rack.

2.7.3.5 There must be one 30A, 220V, circuit with a L6-30R receptacle placed on the back of every rack.

2.7.3.6 There must be a telecommunications-grounding bar located in each hub room that must be and attached to an earth ground.

2.7.3.7 All equipment racks must be grounded to the telecommunications-grounding bus bar.

2.7.3.8 For buildings with one or two TR’s, the University will purchase and install a UPS unit for each rack in each TR.

2.7.3.9 For buildings with more than two hub rooms, the consultant must select an appropriately sized centralized flywheel UPS. This UPS must be in its own room and all circuits in each TR must connect to it either directly or via a sub panel.

2.7.3.10 All UPS units must be connected to circuits that are on a backup generator with an automatic transfer switch.
2.7.4 HVAC

The consultant must specify that TR’s:

2.7.4.1 Must have sufficient cooling to maintain a maximum temperature of 78°F for the lifetime of the room.

2.7.4.2 Must not receive heat from the building’s HVAC system during the winter.

2.7.4.3 Will generate 9,000 BTU/Hr. per rack, and use that figure to determine the TR’s cooling requirements.

2.7.5 Access & Security

The consultant must specify that each TR:

2.7.5.1 Is accessible directly from a hallway.

2.7.5.2 Has card-swpie access.

2.7.5.3 Must not have windows.
2.7.5.4 Must have doors must swing out.

2.7.5.5 Must have doors made of solid wood or metal, without windows or vents.

2.7.5.6 Must not contain building controllers, such as but not limited to, fire alarm, door access, HVAC, and lighting controllers.

2.7.6 Backboards
The consultant must specify:

2.7.6.1 Backboards on all walls of each TR.

2.7.6.2 Backboards are as specified in the Parts & Materials section of this document.

2.8 Radio Frequency Emissions

2.8.1 Overview
2.8.1.1 This section describes the University’s requirements for operating radio frequency emitting equipment on campus.

2.8.1.2 The requirements are divided into interoperability and approval, and safety requirements.

2.8.2 Interoperability & Approval
2.8.2.1 The University operates a wireless network campus wide, indoor and outdoor, that makes extensive use of the public frequency bands at 2.4 and 5 GHz.

2.8.2.2 The University operates a public safety radio system at 700 MHz.

2.8.2.3 The University must approve the use of all radio frequency emitting equipment on campus before it is used.

2.8.2.4 The requestor must provide the University with all relevant information, including but not limited to, frequencies used, output levels, power level predictions, etc., required for the University to make an informed decision.

2.8.3 Safety Requirements
2.8.3.1 All equipment must comply with all applicable rules and regulations of the FCC, including without limitation, those related to radio frequency emissions and exposure.

2.8.3.2 From time to time, but not more often than once per calendar year, the University may require the owner to perform a radio frequency emissions study sufficient to allow the University to determine whether or not the system is in compliance with applicable FCC rules and regulations related to radio frequency emissions and exposure. The owner must provide that survey at no cost to the University.
2.8.3.3 Should any such study show levels violating FCC rules or regulations, the owner shall provide a plan for the University’s review, for controlling access to affected areas, including but not limited to, markers, signage, door locks, rails, and fences, or otherwise cure the FCC violations.

2.8.3.4 Until such plan is implemented, Licensor may, by written notice to Licensee require Licensee must immediately power down the portion of the equipment causing such violations of FCC rules and/or regulations.
3 PARTS & MATERIALS

This section contains a list of acceptable parts and materials. The University requires specific manufacturer and part numbers for some parts and materials. The University defines performance characteristic for all other parts and materials. Any manufacturer/part number meeting the specified performance characteristics is acceptable.

Design consultants must incorporate this information into their construction documents. Bidders bidding on a contract must use this information to select materials upon which they will base their bids. Contractors performing work must use this information to order the appropriate parts and materials.

3.1 Backboards

3.1.1 Backboards must be:

3.1.1.1 3/4 –inch fire resistant plywood with Class A surface.

3.1.1.2 A minimum of 4’ x 8’.

3.2 Cable Supports

1. Cable supports for major hallways must be basket-type.

2. Cable supports for minor hallways must be j-hooks.

3. Cable supports for TR’s must be ladder rack.

4. Acceptable Manufacturer: GS Metals or similar.

3.3 Connecting Blocks

1. All optical fiber cable in all Intermediate Distribution Frame (IDF) rooms must be terminated in fiber termination shelves.

Acceptable unit for IDF’s: Corning (LANscape) CCH-03U w/CCH-CP12-91 connector panels

2. All optical fiber cable in the Main Distribution Frame (MDF) rooms must be terminated in fiber termination shelves and associated equipment.

Acceptable unit for IDF’s: Corning (LANscape) CCH-03U
Multi-mode: CCH-CP12 - 91 connector panels
Single-mode: CCH-CP12 – 59 connector panels

Acceptable unit for MDF’s: Corning (LANscape) CCH-04U

Multi-mode: CCH-CP12 – 91 connector panels
Single-mode: CCH-CP12 – 59 connector panels

3. All copper cabling must be Category 6.
   a. All Category 6 cable utilized for data must be terminated on 48 port Ortronics HDJ Series 48 Port Unloaded Flat Panel Patch Panel, Ortronics Part # OR-PHDHJU48.

   a. Patch panel jacks designated for data or VoIP telephones must be Ortronics Clarity Category 6 High Density Jack, T568A/B, Orange, Ortronics Part # OR-HDJ6-43.

   b. Patch panel jacks designated for wireless access points must be Ortronics Clarity Category 6 High Density Jack, T568A/B, Yellow, Ortronics Part # OR-HDJ6-44.

   c. Patch panel jacks designated for security cameras must be Ortronics Clarity Category 6 High Density Jack, T568A/B, Green, Ortronics Part # OR-HDJ6-45.

OR-HDJ6-43 OR-HDJ6-44 OR-HDJ6-45

4. All analog lines will be terminated on 110 CAT6 blocks.
5. Quantities for all connecting blocks above will be specified by Towson University’s Office of Technology Services in project scope of work.

### 3.4 Equipment Racks

a. Equipment racks must be Mighty Mo 20 Channel Rack, 6.5” Deep Channel, 7’ High, 45RU, Tapped #12-24, Ortronics Part # OR-MM20706-B.

b. Vertical wire management must be Mighty Mo 20 Vertical Wire Managers with a Door, Otronics part #OR-MM20VMD710-B.

c. The contractor must provide four (4) Ortronics Mighty Mo 30 Bend Limiting Clips, Otronics part # OR-MM20BLC-B, per patch panel.

### 3.5 Fiber Optic Terminations

1. The installer must terminate all optical fiber cable installed with a split-ferrule alignment sleeve and a precision ceramic tip. All optical fiber connectors must meet the following technical specifications:

<table>
<thead>
<tr>
<th>Optical Fiber Termination Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connector Type:</td>
</tr>
<tr>
<td>Fiber Outside Diameter:</td>
</tr>
<tr>
<td>Loss Repeat:</td>
</tr>
<tr>
<td>Axial Load Minimum:</td>
</tr>
<tr>
<td>Temperature Stability:</td>
</tr>
</tbody>
</table>

2. Acceptable Manufacturer: Corning

### 3.6 Fire Stopping

A fire stop system is comprised of: the item or items penetrating the fire rated structure, the opening in the structure and the materials and assembly of the materials used to seal the penetrated structure. Fire stop systems comprise an effective block for fire, smoke, heat, vapor and pressurized water stream.

All penetrations i.e. riser, slots and sleeves, and cables, through fire-rated building structures (walls and floors) must be sealed with E-Z Path Series 33 Fire Stop Barrier. This requirement applies to through penetrations (complete penetration) and membrane penetrations (through one side of a hollow fire rated structure).
Any penetrating items such as cable tray, raceways and conduit, etc. must use fire stopping protection that must meet NFPA Life Safety Code #101, 6-2.3.6, “Penetrations and Miscellaneous Openings and Fire Barriers” and the NEC 300.21 “Fire Stopping” regulations and standards.

**3.7 Horizontal Cable**

3.7.1 Horizontal UTP Cable

Horizontal distribution cable for data must be plenum rated twisted pair. Cable for wireless access points must be Category 6A. All other data and telephone cable must be Category 6.

The maximum distance for horizontal distribution cable from the telecommunications closet to wall jack must not exceed 90 meters without prior approval from Towson University’s Office of Technology Services.

The contractor must adhere to the following color-coding for twisted pair cabling:

- Wireless Access Point Cabling must be yellow.
- Security Camera Cabling must be green.
- All other data cabling must be orange.

Acceptable Manufacturer: Berk-Tek, Essex, or Mohawk

3.7.2 Horizontal Coaxial Cable

RG-6 Quad Shield, 75-Ohm Coaxial Cable, Plenum Rated (Commscope: 2227K or equivalent)

**Cable Construction**

**Center Conductor:**
- 18AWG Copper-clad Steel
  - Nom. Dia.: .0403”

**Dielectric:**
- Foam: FEP
  - Dia. over Dielectric: 0.170” Nom.

**Inner Shield:**
- Foil: Aluminum/Poly Tape
  - Braid: 34 AWG Aluminum, 60% Coverage
  - Nom. Dia.: 0.312”

**Outer Shield:**
- Foil: Aluminum/Poly Tape
  - Braid: 34 AWG Aluminum, 40% Coverage
  - Nom. Dia.: 0.332”
Jacket:
- Kynar Flex or Flame Retardant-PVC
- Dia. over Jacket: 0.260” +/- .0004”
- Nom. Jacket Thickness: 0.016”

Electrical Properties:
- Sparker Test: 2500VAC
- Dielectric Test: Conductor to Shield – 2000VDC
- Capacitance: 15.5 pF./Ft. Nom.
- Impedance: 76.0 +/- 2.0 Ohms
- Velocity/Prop.: 84.0% Nom.
- DCR: Conductor: 28.6 Ohms/1000 Ft. Nom
- Shield: 5.30 Ohms/1000 Ft. Nom.

Acceptable manufacturer: Commscope or other approved manufacturer.

### 3.8 J-Hook Pathways

1. All J-hook pathways must support cable runs with a maximum spacing specified as not greater than four feet (4’) between J-hooks. Contractor must submit samples and cut sheets on proposed solutions for Towson University approval.

2. Acceptable Product: Caddy Cat J-Hooks

### 3.9 Outlet Boxes

1. All flush mount electrical J-boxes supporting standard voice/data/video communications must be flush-mounted double-gang galvanized steel boxes with single-gang raised tie covers.

2. All surface mounted boxes supporting standard voice/data/video communications must be double-gang Ortronics plastic boxes.

3. Acceptable Manufacturer: Ortronics

### 3.10 Outside Plant Cable

3.10.1 Outside Plant Fiber Optic Cable

<table>
<thead>
<tr>
<th>Fiber Optic Cable Physical Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cable Core</strong></td>
</tr>
</tbody>
</table>

Parts & Materials
### Parts & Materials

<table>
<thead>
<tr>
<th>Building Interior</th>
<th>Air Core</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building Exterior</td>
<td>Filled core stable from –40F - +140F</td>
</tr>
</tbody>
</table>

#### Cable Composition

<table>
<thead>
<tr>
<th>Building Interior (Station, Plenum)</th>
<th>Fluoropolymer Jacket</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building Interior (Station, Non-Plenum)</td>
<td>PVC Jacket</td>
</tr>
<tr>
<td>Building Interior (Riser)</td>
<td>PVC Jacket</td>
</tr>
<tr>
<td>Building Exterior (Riser)</td>
<td>Non-metallic dielectric</td>
</tr>
<tr>
<td>Cable Strength</td>
<td>Maximum pulling tension –600 lb.</td>
</tr>
<tr>
<td>Minimum Bend Radii</td>
<td>(&lt;30% man. Pull tension) 10 times cable diameter (&gt;30% max. pull tension) 20 times cable diameter</td>
</tr>
<tr>
<td>Fiber Identification</td>
<td>Color-coding system adequate to unambiguously identify each fiber. (See As-Built documentation) The words Fiber Optic Cable(s) must be imprinted on cable no more than one meter apart.</td>
</tr>
</tbody>
</table>

#### 3.10.2 Acceptable manufacturer: any

#### 3.11 Power Receptacles

All receptacle power for data equipment must be fed from standby power panels which are fed from standby or emergency generators via an automatic transfer switch.

1. Data equipment power must be run using all 10 AWG minimum stranded THHN wire in a 3/4” minimum EMT conduit with compression fittings.

2. Required receptacles include 208 volt single phase NEMA L6-20 and / or NEMA L6-30 and 120 volt single phase quad NEMA 5-20 receptacles. All receptacles are to be mounted in a 1910 box. All receptacles must be mounted on the back of the equipment racks only.

NOTE: Before ordering or installing data power, contact Towson University’s Office of Technology Services to verify the types of receptacles needed as well as quantities and locations of each type of receptacle.

#### 3.12 Riser Cable

The structured cabling system with LAN equipment in each Main Distribution Frame (MDF) will require one 12-strand 8.3-micron single-mode optical fiber cable for backbone connectivity between the MDF and each Intermediate Distribution Frame (IDF). This cable must be jacketed as
appropriate for use in a riser or plenum environment. Backbone optical fiber cable must be colored yellow to denote single-mode fiber.

3.12.1 Copper Riser Cable

1. All UTP riser copper cable supporting voice communications requirements must be standard 24-gauge, paired dual, semi-rigid PVC skin over foamed PE, and must meet the following technical specifications:

<table>
<thead>
<tr>
<th>Specification</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Resistance</td>
<td>25.7 Ohms/1000 ft</td>
</tr>
<tr>
<td>Gauge</td>
<td>24 AWG, solid copper conductor, twisted pair</td>
</tr>
<tr>
<td>Mutual Capacitance</td>
<td>15.8 pF/ft</td>
</tr>
<tr>
<td>Characteristic Impedance</td>
<td>650 Ohms @ 1 kHz 105 Ohms @ 1 MHz</td>
</tr>
</tbody>
</table>

2. The attenuation of any pair must not exceed the following values:

<table>
<thead>
<tr>
<th>Frequency (MHz)</th>
<th>Maximum Attenuation (dB per 305 m @ 20 deg. C.)</th>
<th>Maximum Attenuation (dB per 1000 ft @ 20 deg. C.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.002</td>
<td>0.8</td>
<td></td>
</tr>
<tr>
<td>0.008</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>0.064</td>
<td>2.8</td>
<td></td>
</tr>
<tr>
<td>0.256</td>
<td>4.0</td>
<td></td>
</tr>
<tr>
<td>0.512</td>
<td>5.6</td>
<td></td>
</tr>
<tr>
<td>0.772</td>
<td>6.7</td>
<td></td>
</tr>
<tr>
<td>1.0</td>
<td>7.6</td>
<td></td>
</tr>
<tr>
<td>4.0</td>
<td>15.4</td>
<td></td>
</tr>
<tr>
<td>8.0</td>
<td>22.3</td>
<td></td>
</tr>
<tr>
<td>10.0</td>
<td>25.0</td>
<td></td>
</tr>
<tr>
<td>16.0</td>
<td>32.0</td>
<td></td>
</tr>
</tbody>
</table>

3. The characteristic impedance of any pair must meet the following requirements:

<table>
<thead>
<tr>
<th>Frequency (MHz)</th>
<th>Characteristic Impedance (Ohms.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.064</td>
<td>120 +/- 15%</td>
</tr>
<tr>
<td>0.128</td>
<td>110 +/- 15%</td>
</tr>
<tr>
<td>0.256</td>
<td>105 +/- 15%</td>
</tr>
</tbody>
</table>
4. The Near-End Cross talk (NEXT) coupling loss between pairs within a cable must be equal to or greater than the following:

<table>
<thead>
<tr>
<th>Frequency (MHz)</th>
<th>NEXT Loss Worst Pair (dB @ 305 m) (dB @ 1000 ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.150</td>
<td>52</td>
</tr>
<tr>
<td>0.772</td>
<td>41</td>
</tr>
<tr>
<td>1.576</td>
<td>37</td>
</tr>
<tr>
<td>3.15</td>
<td>32</td>
</tr>
<tr>
<td>6.3</td>
<td>28</td>
</tr>
<tr>
<td>10.0</td>
<td>25</td>
</tr>
<tr>
<td>16.0</td>
<td>23</td>
</tr>
</tbody>
</table>

5. Acceptable Manufacturer: Berk-Tek or Ortronics or other approved manufacturer

3.12.2 Fiber Optic Riser Cable

2. All backbone Optical Fiber must be 8.3-micron single-mode fiber.

<table>
<thead>
<tr>
<th>Core Type:</th>
<th>Graded Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core Diameter:</td>
<td>8.3 (+/- 6) microns</td>
</tr>
<tr>
<td>Core Eccentricity:</td>
<td>1.5% Nominal – 7.5% Max.Core</td>
</tr>
<tr>
<td>Ovaity:</td>
<td>4% Nominal – 20% Max</td>
</tr>
<tr>
<td>Cladding Diameter:</td>
<td>125 (+/- 2) microns</td>
</tr>
<tr>
<td>Cladding Non-Circularity:</td>
<td>2% Maximum</td>
</tr>
<tr>
<td>Coating Diameter:</td>
<td>245 (+9/-13) microns</td>
</tr>
<tr>
<td>Refracting Index Delta:</td>
<td>2.0% (+/- .3%)</td>
</tr>
<tr>
<td>Numerical Aperture:</td>
<td>0.29</td>
</tr>
<tr>
<td>Bandwidth Windows:</td>
<td>Dual-850 nm – 3.5 dB</td>
</tr>
<tr>
<td>Maximum Attenuation:</td>
<td>850 nm – 3.5 dB</td>
</tr>
<tr>
<td></td>
<td>1300 nm – 1.5 dB</td>
</tr>
<tr>
<td>Typical Bandwidth:</td>
<td>850 nm – 400 MHz/km</td>
</tr>
<tr>
<td></td>
<td>1300 nm – 500 MHz/km</td>
</tr>
</tbody>
</table>
3. All fiber cable used must have the following physical characteristics:

<table>
<thead>
<tr>
<th>Fiber Optic Cable Physical Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cable Core</strong></td>
</tr>
<tr>
<td>Building Interior</td>
</tr>
<tr>
<td>Building Exterior</td>
</tr>
<tr>
<td><strong>Cable Composition</strong></td>
</tr>
<tr>
<td>Building Interior (Station, Plenum)</td>
</tr>
<tr>
<td>Building Interior (Station, Non-Plenum)</td>
</tr>
<tr>
<td>Building Interior (Riser)</td>
</tr>
<tr>
<td>Building Exterior (Riser)</td>
</tr>
<tr>
<td><strong>Cable Strength</strong></td>
</tr>
<tr>
<td>Minimum Bend Radii (&lt;=30% man. Pull tension)</td>
</tr>
<tr>
<td>Minimum Bend Radii (&gt;30% max. pull tension)</td>
</tr>
<tr>
<td>Fiber Identification</td>
</tr>
</tbody>
</table>

4. Acceptable Manufacturer: Any

3.12.3 Coaxial Riser Cable

RG-11 Quad Shield, 75-Ohm Coaxial Cable, Plenum Rated
(Commscope: 22827K or equivalent)

Cable Construction
Center Conductor:
18AWG Copper-clad Steel
Nom. Dia.: .0641”

Dielectric:
Foam: FEP
Dia. over Dielectric: 0.28” Nom.

Inner Shield:
Foil: Aluminum/Poly Tape
Braid: 34 AWG Aluminum, 60% Coverage
Nom. Dia.: 0.312”

Outer Shield:
- Foil: Aluminum/Poly Tape
- Braid: 34 AWG Aluminum, 40% Coverage
Nom. Dia.: 0.332”

Jacket:
- Flame Retardant PVDF Jacket
- Dia. over Jacket: 0.372”
- Nom. Jacket Thickness: 0.020”

Electrical Properties:
- Capacitance: 16pF/ft
- Impedance: 76.0 +/- 3.0 Ohms
- Velocity/Prop.: 84.0% Nom.
- Max DC Loop Resistance 3.90 Ohms/1000 Ft. Nom

3.13 Splice Cases

All building entrance Splice Cases must be 3-M type closure and accessories.

3.14 Unspecified Equipment

1. Any item of equipment or material not specifically addressed on the drawings or in this document and required to provide a complete and functional PDS installation must be provided in a level of quality consistent with other specified items. Towson University must retain the right to review and approve all products not specified.
3.15 Voice/Data Jacks and Cover Plates

1. The jack assembly to support UTP voice and data connectivity requirements must be a modular, eight (8) conductor (8P8C) Category 6 (voice/data) performance rated, and communications outlet. Jacks must be Ortronics TracJack OR-TJ600-23 (light orange in color) for data drops and Ortronics TracJack OR-TJ600 (white in color) for analog voice drops. Faceplates must be white in color.

   OR-TJ600-23   OR-TJ600

2. The “pin-out” wiring assignment for the 4 pair UTP copper cable for data communications at the outlet jack and at the TC connection must be consistent with EIA/TIA T568B. The “pin-out” wiring assignment for the 4 pair UTP copper cable for voice communications will be as specifically stated on Page 22, Station Cabling and Installation.

3. Back to back outlets in the same wall or thru-wall type boxes are not permitted. To maximize sound control, outlets on opposite sides of a common wall must be offset at least 6 inches.

4. Station outlet boxes must be installed at the same elevation as the other outlets in the room. As a general guideline. Mount the station outlet boxes as follows: (dimensions are from the finished floor to the center line of unobstructed outlets)

   Standard Communications Outlet - 18”
   Wall mounted, where wheel chair persons can only approach head-on - 4'0”

5. Video connectors should be “F” type with female connections on each end.

6. Standard Communication Outlet Layout
Execution

7. Acceptable Product: Ortronics TracJack
4 PART 4 – EXECUTION

4.1 General Execution Requirements

The contractor must execute all work in accordance with this document, BISCI, EIA/TIA, NFPA, NEC, and IEEE standards, whichever is most stringent. The requirements listed here highlight specific requirements which the University considers important or otherwise feels it needs to specifically state.

The contractor must:

1. Execute all work in accordance with this document, BISCI, EIA/TIA, NFPA, NEC, and IEEE standards, whichever is most stringent.

2. Install cable system in a manner that provides mechanical integrity for the cabling media and any associated frames and racks and allows for ease of access.

3. Install cable in cable trays, j-hooks, conduits, sleeves, and chases, when such supports exist.

4. Install appropriate carriers to support installed cabling where appropriate support does not exist.

5. Install cable support systems such as J-hooks or other carriers that do not provide continuous cable support at intervals no greater than 3 feet.

6. Install cable service loops above ceilings over jack locations.

7. Verify that installation sites are ready to begin work before beginning work.

8. Coordinate their work with Towson University and appropriate trades involved with project.

9. Verify the locations for ladder racks, equipment racks, patch panels, and wire management with the University’s Office of Technology Services in all IDF and MDF’s prior to beginning their installation.

4.2 Unacceptable Work

The University prohibits the following except where specifically indicated in construction drawings or scope of work, or when authorized by the University’s Office of Technology Services in writing prior to execution. Specifically, the contractor must not:

1. Splice copper, coaxial, UTP, or any other telecommunications cable inside a building.

2. Install cable aerially.
3. Attach cable to anything other than the telecommunications cable support system.

4. Attach cable supports to anything other than the building structure.

5. Install cable or cable supports where interferes with the operation or maintenance of any other building systems or components, or impairs access to the same.

6. Lay cable on the ceiling grid, lighting fixtures, or other cables.

7. Attach cable support systems to anything other than the concrete deck.

8. Install service loops for cable inside any IDF or MDF.


4.3 Coordination with Other Trades

1. All cable in accessible spaces must be designed and installed for easy access. Cable paths above suspended ceilings, mechanical rooms, closets, etc., must not be blocked or covered in any way that would impede the addition of cable in the future.

4.4 Labeling

Towson University’s labeling standard is based on the 606A labelling standard. As such, it uses specific identifiers, which are defined in this section.

4.4.1 TR ID

A TR ID’s is a two-character identifier, such as “1A”, “2C”, or “3A”, where the characters correspond to the floor number and a closet letter that uniquely identifies it on its floor. The contractor must obtain the list of TR ID’s from the Office of Technology Services.

4.4.2 Patch Panel ID

A Patch Panel ID is a single capital letter that uniquely identifies a patch panel within a TR. Patch panel “A” is assigned to the top patch panel in the left-most rack. The other patch panels ID’s are assigned alphabetically, from top to bottom of each rack, then from left-most rack to right-most rack. In cases where racks are one in front of the other, the labels go top to bottom of each rack, then from front-most rack to rear-most rack. The drawing below shows how to assign Patch Panel ID’s.
4.4.3 Patch Panel Jack ID

The Patch Panel Jack ID is a zero-padded two-digit number that uniquely identifies a jack on a patch panel. Patch Panel ID’s are 1-48. Most panels already have jack labelled 1-48. However, if the panel is not labelled, or labelled in another manner, the contractor label the panels jacks 1-48 with the top row being 1-24 from left to right and the bottom row being 25-48 from left to right.

4.4.4 End Station Jack ID

End Station Jack ID’s identify a specific cable installed in a faceplate at the end station location. It has the following format: AA-BC, where AA is the TR ID, B is the Patch Panel ID, and C is the Patch Panel Jack ID. For example, “1B-C32” indicates the cable goes to the telecommunications room with TR ID “1B” and terminates on patch panel C, on patch panel jack 32.

For horizontal cable, the contractor must:

1) Request labeling instructions from the University’s Office of Technology Services prior to the start of labeling if the construction document or scope of work does not contain labeling instructions.

2) Request that the University provide the 606A TR ID’s for each telecommunications room prior to beginning work.

3) Affix a label to the left-hand side of each patch panel that contains the patch panel’s Panel ID.
4) Affix a label containing the Patch Panel Jack ID under each patch panel jack if the patch panel does not already contain Patch Panel Jack ID’s.

5) Affix a label in the label slot on each faceplate that provides the End Station Jack ID for each cable terminated in it.

6) Affix a label with the End Station Jack ID within 4 inches of the end of all end-station cables terminated with an RJ45 on the end-station side.

7) Print all labels with a label making device.

For riser cable, the contractor must:

1. Affix a label containing the Cable ID within 12 inches of:
   a. Entering and exiting an LIU.
   b. Entering and exiting a splice case.
   c. Entering and exiting a conduit, wall or floor penetration, or any other area where the cable disappears from view.

2. Affix an LIU Module Label to the outside of each LIU for each module where the contractor terminated a strand of fiber.

4.4.5 Fiber Optic Riser Cables

Each fiber optic riser cable has an identifier of the following form: AA/BB-CC, where AA is the TR ID of the MDF, BB is the TR ID of the IDF, and CC is a zero-padded 2-digit number that makes the label unique. For example, if the first cable run between TR 1A and 2B is 1A/2B-01, the second is 1A/2B-02, etc.

For each cable, the contractor must affix a label containing the cable’s identifier within 12 inches of:

1. Entering an LIU.

2. Entering or leaving a splice case.

3. Entering or exiting a conduit, penetration, or any other area where it disappears from view.

The contractor must also affix labels to the LIU to indicate where the individual strands are terminated. These labels must be of the following form:

Module Letter: End Station Jack ID 1A - End Station Jack ID.B, where A is the first strand number terminated on the module and B is the last.

For example, if a 48-strand cable is terminated in slots A, B, C, and D, the contractor must affix a label to the LIU that looks like this:
4.4.6 Fiber Optic OSP Cables

4.4.7 Copper Cables

4.5 Grounding and Bonding Requirements

The facility must be equipped with a Telecommunications Bonding Backbone (TBB). This backbone must be used to ground all telecommunications cable shields, equipment, racks, cabinets, raceways, and other associated hardware that has the potential to act as a current carrying conductor.

1. The TBB must be installed independent of the building’s electrical and building ground and must be designed in accordance with the recommendations contained in the ANSI/TIA/EIA-607 Telecommunications Bonding and Grounding Standard.

2. The main entrance facility/equipment room in each building must be equipped with a telecommunications main grounding bus bar (TMGB).

3. Each telecommunications room must be provided with a telecommunications ground bus bar (TGB).

4. The TMGB must be connected to the building electrical entrance grounding facility. The intent of this system is to provide a grounding system that is equal in potential to the building electrical ground system. Therefore, ground loop current potential is minimized between telecommunications equipment and the electrical system to which it is attached.

5. All racks, metallic backboards, cable sheaths, metallic strength members, splice cases, cable trays, etc. entering or residing in the MDF or IDF must be grounded to the respective TGB or TMGB using a minimum #6 AWG stranded copper bonding conductor and compression connectors.

6. All wires used for telecommunications grounding purposes must be identified with a green insulation. Non-insulated wires must be identified at each termination point with a wrap of green tape. All cables and bus bars must be identified and labeled in accordance with the System Documentation Section of this specification.

7. All ladder rack installed in hallways must be grounded and bonded.
4.6 Testing and Inspection

1. Upon completion of the project, Towson University’s OTS Technical Representative will perform a final inspection of the installed cabling system with the Contractor’s Project Foreman. The final inspection will be performed to validate that all horizontal and backbone cables were installed as defined in the drawing package, and that the installation meets the aesthetic expectations of the Owner.

2. Upon receipt of the test documentation, Towson University reserves the right to perform spot testing of a representative sample of the cabling system to validate test results provided in the test document. Towson University testing will use the same method employed by the contractor, and minor variations will be allowed to account for differences in test equipment. If significant discrepancies are found the contractor will be notified for resolution.

3. Prior to acceptance, all “As-Built” and technical documentation must be received and approved by the University. As-built documentation must include the completed and notarized original copy of the Premises Distribution System Registration Document, if applicable. All intra-building and inter-building wiring and equipment, and all site restoration must be installed and completed in accordance with Towson University and industry standards. All wiring and equipment provided and/or installed under this contract must be tested as described under the terms of this contract and must be fully operational. After all work is complete, the Contractor must also provide Towson University with Structured Cabling System Certification for all communications work completed on the project.

4. Testing of all copper wiring must be performed prior to system cutover. 100 percent of the horizontal and rise wiring pairs must be tested for opens, shorts, polarity reversals, transpositions and presence of AC voltage. Voice and data horizontal wiring pairs must be tested from the information outlet to the TC. The Category 6 cable runs for data communications must be tested for conformance to the specifications of EIA/TIA 568B Category 6. Testing must be done with a TIA/EIA TSB-67 UL Certified Level 2 test set. The Category 6 cable runs for voice communications must be tested for continuity only. Test must include length, mutual capacitance, characteristic impedance, attenuation, and near end and far end cross talk. The contractor, at no charge, must bring any pairs not meeting the requirements of the standard into compliance.

5. Fiber testing must be performed on all fibers in the completed end-to-end system. Testing must consist of a bi-directional end to end OTDR trace performed per EIA/TIA 455-61 for OSP and a bi-directional end to end power meter test performed per EIA/TIA 455-53A for ISP. The system loss measurements must be provided at 850 and 1310 nanometers for multimode fibers and 1310 and 1550 for single mode fibers.

6. Complete, end-to-end test results for all installed fiber & copper cabling must be submitted to Towson University in one (1) Microsoft Excel 2000 (.xls) soft copy file and one (1) hard copy.
4.7 System Performance

During the three (3) week period between final inspection and delivery of the test and as-built documentation, Towson University will activate the cabling system. Towson University will validate operation of the cabling system during this period.

4.8 Final Acceptance

Completion of the installation; in-progress and final inspections; receipt of the test and as-built documentation; and successful performance of the cabling system for a three (3) week period will constitute acceptance of the system.

4.9 As Built Documentation

1. The contractor must provide the following outside plant wiring information, prior to acceptance of the building by Towson University, for each of the specified media:
   a. End Station Jack Identification number (Copper).
   b. Cable design makeup (Copper).
   c. Cable lengths between splice points.
   d. Exact routing of cable (Copper).
   e. Splice location and identification (Copper).
   f. Bonding and grounding (Copper, Fiber, Coax).
   g. Location and description of all associated equipment (Copper).
   h. Location and description of all associated structures and obstructions (Copper).

2. The contractor must provide the following intra-building wiring information for each specified media prior to acceptance of the building by Towson University:
   a. Cable entrance locations and penetrations details (copper).
   b. Location and identification of all distribution closets and of all equipment located inside distribution closets (Copper).
   c. Terminal information, jack numbering, and pair count information at each distribution frame (Copper).
   d. Schematic drawings of riser (Copper).
   e. Routing of cable and termination information (Copper).
3. The Contractor must provide the following MDF wiring information prior to acceptance of the building by Towson University:
   
   a. Cable pair assignments per connector block.
   
   b. Identification of cable routing to MDF (1st Floor).

4. The Contractor must provide a complete listing of pair assignment records for copper wiring. Copper cable records must include the status of each copper pair.

5. The Contractor must provide Towson University with the operational and maintenance documentation of all telecommunications equipment installed under this contract.

6. Contractor must submit all drawings electronically utilizing AutoCAD version (xxx).

7. Cable test results will be submitted in Microsoft Excel 2000 spreadsheet (.xls) format.

### 4.10 Warranty

1. The contractor must warrant and guarantee to Towson University, without limitations or qualifications that all equipment, components, material and workmanship must perform in accordance with local and national codes and the specifications of this document.

2. The warranty period must be for two (2) years from the time of final acceptance by Towson University.
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM</td>
<td>American Society for Testing and Materials</td>
</tr>
<tr>
<td>AWG</td>
<td>American wire gauge</td>
</tr>
<tr>
<td>BISCI</td>
<td>Building Industry Consulting Service International</td>
</tr>
<tr>
<td>CMP</td>
<td>Communications Plenum Cable</td>
</tr>
<tr>
<td>End Station device</td>
<td>A location outside of a TR at which a person connects a data network or telephone</td>
</tr>
<tr>
<td>EIA/TIA (TIA)</td>
<td>Electronic Industry Association (EIA)/Telecommunications Industry Association</td>
</tr>
<tr>
<td>EMT</td>
<td>Electrical metallic tubing</td>
</tr>
<tr>
<td>FEP</td>
<td>Fluorinated Ethylene Propylene</td>
</tr>
<tr>
<td>IDF</td>
<td>Intermediate distribution frame</td>
</tr>
<tr>
<td>IEEE</td>
<td>Institute of Electrical and Electronics Engineers</td>
</tr>
<tr>
<td>Installer</td>
<td>A person or company that installs IT infrastructure defined in this document.</td>
</tr>
<tr>
<td>ISP</td>
<td>Inside Plant</td>
</tr>
<tr>
<td>MDF</td>
<td>Main distribution frame</td>
</tr>
<tr>
<td>NEC</td>
<td>National Electrical Code</td>
</tr>
<tr>
<td>NFPA</td>
<td>National Fire Protection Association</td>
</tr>
<tr>
<td>OFNP</td>
<td>Optical Fiber Nonconductive Plenum</td>
</tr>
<tr>
<td>OSP</td>
<td>Outside Plant</td>
</tr>
<tr>
<td>OTDR</td>
<td>Optical Time Domain Reflectometer</td>
</tr>
<tr>
<td>PBX</td>
<td>Private Branch Exchange</td>
</tr>
<tr>
<td>PE</td>
<td>Polyethylene</td>
</tr>
<tr>
<td>PVC</td>
<td>Polyvinyl Chloride plastic</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Definition</td>
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<td>--------------</td>
<td>------------</td>
</tr>
<tr>
<td>RMT</td>
<td>Rigid Metallic Tubing</td>
</tr>
<tr>
<td>TGB</td>
<td>Telecommunications grounding bus bar</td>
</tr>
<tr>
<td>TMGB</td>
<td>Telecommunication’s main grounding bus bar</td>
</tr>
<tr>
<td>TR</td>
<td>Telecommunications Room (an IDF or MDF)</td>
</tr>
<tr>
<td>UL</td>
<td>Underwriter's Laboratory</td>
</tr>
<tr>
<td>UTP</td>
<td>Unshielded twisted pair</td>
</tr>
</tbody>
</table>
6 Change Log
BID/PRICE PROPOSAL FORM

BIDDER’S NAME: ____________________________

PROJECT TITLE: 7800 York Rd 1st and 2nd Floor Renovation

PROJECT NUMBER: TU-1949-SBR

Failure to properly complete each blank may be cause for rejection of this proposal.

Having carefully examined the solicitation documents, including all addenda acknowledged on Exhibit K attached hereto, being collectively referred to as the Contract Documents, and having received clarification on all items of conflict or upon which any doubt arose, the undersigned proposes to furnish all labor, materials and equipment required by the said documents for the entire work, all in strict accordance with the Contract Documents, for the sum of:

TOTAL COST OF PROJECT

BASE BID ____________________________ $

Words ____________________________ Numbers

If the undersigned is notified by the Procurement Officer/Representative of the acceptance of the bid within 90 days after the bid date, Contractor agrees to guarantee the completion of this work as specified in the Contract Documents.

Firm License Number
(If Applicable)

Date Issued

Place of Issuance

Minority Business Enterprises:

The undersigned certifies that the Bidder:

_____ IS NOT a Certified Minority Business Enterprise.

_____ IS a Minority Business Enterprise (MBE), certified by the Maryland Department of Transportation, and assigned the following certification number: ____________________________

(Certification Number)
The undersigned affirms, and it is a condition precedent to acceptance of this bid, that the bidder has not been a party to any agreement to bid a fixed or uniform price.

INDIVIDUAL PRINCIPAL

Firm Name: ________________________________
Address: __________________________________
________________________________________
Phone/Fax No.: _____________________________
E-mail Address: ____________________________

Witness: ___________________________ Signed: ___________________________

CO-PARTNERSHIP PRINCIPAL

Address: __________________________________
________________________________________
Phone/Fax No.: _____________________________
E-mail Address: ____________________________

Federal Tax ID or Social Security No.

In the Presence of

Witness: ___________________________ By: ___________________________
Witness: ___________________________ By: ___________________________
Witness: ___________________________ By: ___________________________

Partner

CORPORATE PRINCIPAL

Name of Corporation

Address: _________________________________
________________________________________
Phone/Fax No.: _____________________________
E-mail Address: ____________________________

Federal Tax ID Number

By: ______________________________________
Signature of Officer or Authorized Agent
(Affix Corporate Seal)

Printed Name

Title

Witness: _________________________________
The provisions contained in this exhibit will be incorporated and be a part of the contract entered into between Towson University and any contractors as a result of this procurement.

1. **Affirmation - Contingent Fees**
The Contractor shall submit with its bid/proposal a Procurement Affirmation regarding contingent fees in the form required by USM Procurement Policies and Procedures.

2. **Affirmation - Debarment**
The Contractor shall submit with its bid/proposal a Procurement Affirmation in the form required by USM Procurement Policies and Procedures.

3. **Affirmation Regarding Debarment of Related Entities**
The Contractor shall submit with its bid/proposal a Procurement Affirmation regarding debarment of related entities in the form required by USM Procurement Policies and Procedures.

4. **Affirmation - Non-Collusion**
The Contractor shall submit with its bid/proposal a Non-Collusion Affirmation in the form required by USM Procurement Policies and Procedures.

5. **Affirmation Regarding Bribery Convi ctions**
The offeror warrants that neither it nor any of its officer, directors, or partners not any of its employees who are directly involved in obtaining or performing contracts with any public body has been convicted of bribery, attempted bribery, or conspiracy to bribe under the laws of any state or of the federal government or has engaged in conduct since July 1, 1977, which would constitute bribery, attempted bribery, or conspiracy to bribe under the laws of any state or the federal government.

The Contractor shall submit with its bid/proposal a Procurement Affirmation regarding bribery convictions in the form required by University System of Maryland (USM) Procurement Policies and Procedures.

6. **Affirmation Regarding Other Convictions**
The Contractor shall submit with its bid/proposal a Procurement Affirmation regarding other convictions in the form required by USM Procurement Policies and Procedures.

7. **Affirmation Regarding Sub-Contractors**
The Contractor shall submit with its bid/proposal a Procurement Affirmation regarding debarment of sub-contractors in the form required by USM Procurement Policies and Procedures.

8. **Affirmation - Drug and Alcohol Free Workplace**
The contractor warrants that the contractor shall comply with COMAR 21.11.08 Drug and Alcohol Free Workplace, and that the contractor shall remain in compliance throughout the term of this contract.

9. **Certification of Corporation Registration and Tax Payment**
The Contractor shall submit with its bid/proposal a Procurement Affirmation regarding certification of corporation registration and tax payment in the form required by USM Procurement Policies and Procedures.

10. **Affirmation - Financial Disclosure**
The Contractor shall submit with its bid/proposal a Financial Disclosure Affirmation in the form required by USM Procurement Policies and Procedures.

11. **Affirmation - Political Contribution Disclosure**
The Contractor shall submit with its bid/proposal a Political Contribution Disclosure Affirmation in the form required by USM Procurement Policies and Procedures.

12. **Contract Affidavit**
The successful bidder shall submit, prior to contract award, a Contract Affidavit in the form required by USM Procurement Policies and Procedures.

13. **Affirmative Action**
The Contractor and all subcontractors shall develop and maintain affirmative action plans directed at increasing the utilization of women and members of minority groups on State public works projects, pursuant to the Executive Order 11246 of the President of the United States of America and guidelines on Affirmative Action issued by the Equal Employment Opportunities Commission (EEOC) 29 C.F.R. part 1608 and the Governor of Maryland's Executive Order 01.01.1993.16.

14. **Amendments and Modifications**
The contract documents, as defined within the contract, constitute the entire agreement between the parties hereto. All other communications between the parties prior to execution of the contract, whether written or oral, with reference to the subject matter of the contract are superseded by the agreement contained therein. No amendment of this contract shall be binding unless in writing and signed by the parties. Amendments may not significantly change the scope of the contract.

15. **Civil Rights Act of 1964**
Contractors providing materials, equipment, supplies or services to the State under the contract herewith assure the State that they are conforming to the Civil Rights Act of 1964, the Civil Rights Restoration Act of 1988, the Civil Rights Act of 1991, and Section 202 of Executive Order 11246 of the President of the United States of America as amended by Executive Order 11375, as applicable.

16. **Compliance with Laws**
The Contractor hereby represents and warrants that:

a. It is qualified to do business in the State of Maryland, and that it will take such action, as from time to time hereafter, may be necessary to remain so qualified;

b. It is not in arrears with respect to the payment of any monies and owing the State of Maryland, or any department or agency thereof, including but not limited to the payment of taxes and employee benefits, and that it shall not become so in arrears during the term of the contract;

c. It shall comply with all federal, State and local laws, ordinances applicable to its activities and obligations under the contract; and;
d. It shall procure, at its expense, all licenses, permits, insurance and governmental approval, if any, necessary to the performance of its obligations under the contract.

17. Compensation and Method of Payment
Contractor agrees to include on the face of all invoices billed to the University, its Taxpayer Identification Number, which is the Social Security Number for individuals and sale proprietors and the Federal Employee Identification Number for all other types of organizations.

18. Confidentiality; dissemination of Information
Contractor shall not release any information related to services or performance of the services under this Contract, nor publish any final reports or documents without the prior written approval of the University. Contractor shall indemnify and hold harmless the State and the University, its officers, agents and employees from all harm which may be incurred by reason of dissemination, publication, distribution or circulation, in any manner whatsoever, of any information, data, documents, or materials pertaining in any way to this Contract by Contractor, its agents or employees.

19. Conflict of Interest Law
It is unlawful for any State officer, employee, or agent to participate personally in his official capacity through decision, approval, disapproval, recommendation, advice, or investigation in any contract or other matter in which he, his spouse, parent, child, brother, or sister has a financial interest or to which any firm, corporation, association, or other organization in which he has a financial interest or in which he is serving as an officer, director, trustee, partner, or employee, or any person or organization with whom he is negotiating or has any arrangement concerning prospective employment, is a party, unless such officer, employee, or agent has previously complied with the provisions of State Government Article § § 15-501 et seq. of the Annotated Code of Maryland.

20. Contract Modifications and Changes
a. The procurement officer unilaterally may, at any time, without notice to the sureties, if any, by written order designed or indicated to be a change order, make any change in work within the general scope of the contract, including but not limited to changes:

(1) In the specifications (including drawings and designs);
(2) In the method or manner of performance of the work;
(3) In the State-furnished facilities, equipment, materials, services, or site; or
(4) Directing acceleration in the performance of the work.

b. Any other written order or an oral order, including a direction, instruction, interpretation or determination, from the procurement officer that causes any such change, shall be treated as a change order under this clause, provided that the Contractor gives the procurement officer written notice stating the date, circumstances, and source of the order and that the Contractor regards the order as a change order.

c. Except as herein provided, no order, statement, or conduct of the procurement officer shall be treated as a change under this clause or entitle the Contractor to an equitable adjustment hereunder.

d. Subject to paragraph f., if any change under this clause causes an increase or decrease in the Contractor's cost of, or the time required for, the performance of any part of the work under this contract, whether or not changed by any order, an equitable adjustment shall be made and the contract modified in writing accordingly; provided, however, that except for claims based on defective specifications, no claim for any change under (b.) above shall be allowed for any costs incurred more than 20 days before the Contractor gives written notice as therein required; and provided further, that in the case of defective specifications for which the State is responsible, the equitable adjustment shall include any increased cost reasonably incurred by the Contractor in attempting to comply with such defective specifications.

e. If the Contractor intends to assert a claim for an equitable adjustment under this clause, he shall, within 30 days after receipt of a written change order under a. above or the furnishing or written notice under b. above, submit to the procurement officer a written statement setting forth the general nature and monetary extent of such claim, unless this period is extended by the University. The statement of claim hereunder may be included in the notice under b. above.

f. Each contract modification or change order that affects contract price shall be subject to the prior written approval of the procurement officer and other appropriate authorities and to prior certification of the appropriate fiscal authority of fund availability and the effect of the modification or change order on the project budget or the total construction cost. If, according to the certification of the fiscal authority, the contract modification or change order will cause an increase in cost that will exceed budgeted and available funds, the modification or change order may not be made unless sufficient additional funds are made available or the scope of the project is adjusted to permit its completion within the project budget.

g. No claim by the Contractor for an equitable adjustment hereunder shall be allowed if asserted after final payment under the contract.

21. Contractor’s On-Site Representative
The Contractor is required to maintain on site at all times when the work is in progress on this project an individual who represents the Contractor, is responsible for the entire project, and can communicate in English with the University's representative.

22. Contractor’s Invoices
Contractor shall include its Taxpayer Identification Number on the face of each invoice billed to the University. If a Purchase Order document is issued, the Purchase Order Number must be included.

23. Cooperation with University and State Representatives
Before any of the work shall begin, the Contractor shall confer with the University's representative at the site and agree on a sequence of procedure, means of access to the premises, space for storage of materials and equipment, use of approaches, use of facilities, etc.

24. Cost and Price Certification
The Contractor, by submitting cost or price information certifies that, to the best of its knowledge, the information submitted is accurate, complete, and current as of a mutually determined specified date prior to the conclusion of any price discussions or negotiations for:

a. A negotiated contract, if the total contract price is expected to exceed $100,000 or a smaller amount set by the procurement officer; or

b. A change order or contract modification, expected to exceed $100,000 or a smaller amount set by the procurement officer.

c. The price under this contract and any change order or modification hereunder, including profit or fee, shall be adjusted to exclude any significant price increases occurring because the Contractor furnished cost or price information which, as of the date agreed upon between the parties, was inaccurate, incomplete, or not current.

25. Default Delay and Time Extension
Termination for Default — Damages for Delay — Time Extensions

(1) If the Contractor refuses or fails to prosecute the work, or any separable part thereof, with such diligence as shall insure its completion within the time specified in this contract, or any extension thereof, or fails to complete said work within this time, the State may, by written notice to the Contractor, terminate his right to proceed with the work or the part of the work as to which there has been delay. In this event the State may take over the work and prosecute the same to completion, by contract or otherwise, and may take possession of and
utilize in completing the work the materials, appliances, and plant as may be on the site of the work and necessary therefor. Whether or not the Contractor's right to proceed with the work is terminated, he and his sureties shall be liable for any damage to the State resulting from his refusal or failure to complete the work within the specified time.

2. If fixed and agreed liquidated damages are provided in the contract and if the State so terminates the Contractor's right to proceed, the resulting damage shall consist of such liquidated damages until a reasonable time as may be required for final completion of the work together with any increased costs occasioned the State in completing the work.

3. If fixed and agreed liquidated damages are provided in the contract and if the State does not so terminate the Contractor's right to proceed, the resulting damage shall consist of these liquidated damages until the work is completed or accepted.

4. The Contractor's right to proceed may not be so terminated nor the contractor charged with resulting damages if:

(a) The delay in the completion of the work arises from unforeseeable causes beyond the control and without the fault or negligence of the Contractor, including but not restricted to, acts of God, acts of the public enemy, acts of the State in either its sovereign or contractual capacity, acts of another Contractor in the performance of a contract with the State, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, unusually severe weather, or delays of subcontractors or suppliers arising from unforeseeable causes beyond the control and without the fault or negligence of both the Contractor and the subcontractors or suppliers; and

(b) The Contractor, within 10 days from the beginning of any such delay (unless the procurement officer grants a further period of time before the date of final payment under the contract), notifies the procurement officer in writing of the causes of delay. The procurement officer shall ascertain the facts and the extent of the delay and extend the time for completing the work when, in his judgement, the findings of fact justify such an extension, and his findings of fact shall be final and conclusive on the parties, subject only to appeal as provided in the "Disputes" clause of this contract.

5. If, after notice of termination of the Contractor's right to proceed under the provisions of this clause, it is determined for any reason that the Contractor was not in default under the provisions of this clause, or that the delay was excusable under the provisions of this clause, the rights and obligations of the parties shall, if the contract contains a clause providing for termination for convenience of the State, be the same as if the notice of termination had been issued pursuant to the clause. If, in the foregoing circumstances, this contract does not contain a clause providing for termination for convenience of the State, the contract shall be equitably adjusted to compensate for the termination and the contract modified accordingly; failure to agree to any such adjustment shall be a dispute concerning a question of fact within the meaning of the clause of this contract entitled "Disputes".

6. The rights and remedies of the State provided in this clause are in addition to any other rights and remedies provided by law or under this contract.

7. As used in paragraph (4)(a) of this clause, the term "subcontractors or suppliers" means subcontractors or suppliers at any tier.

26. Delivery and Acceptance

Delivery shall be made in accordance with the specifications. The University reserves the right to test any materials, equipment, supplies, or services delivered to determine if the specifications have been met. The materials listed in the specifications shall be delivered FOB the point or points specified prior to or on the date specified in the solicitation. Any material that is defective or fails to meet the terms of the specifications may be rejected. Rejected materials shall be promptly replaced. The State reserves the right to purchase replacement materials in the open market. Vendors failing to promptly replace materials lawfully rejected shall be liable for any excess price paid for the replacement, plus applicable expenses, if any.

27. Disputes

a. This contract is subject to the USM Procurement Policies and Procedures.

b. Except as otherwise provided in this contract or by law, all disputes arising under or as a result of a breach of this contract that are not disposed of by mutual agreement shall be resolved in accordance with this clause.

c. As used herein, claim means a written demand or assertion by one of the parties seeking, as a legal right, the payment of money, adjustment or interpretation of contract terms, or other relief, arising under or relating to this contract. A voucher, invoice, or request for payment that is not in dispute when submitted is not a claim under this clause. However, if the submission subsequently is not acted upon in a reasonable time, or is disputed as to liability or amount, it may be converted to a claim for the purpose of this clause.

d. Within 30 days after contractor knows or should have known of the basis for a claim relating to this contract, contractor shall file a written notice of claim with the procurement officer.

e. Contemporaneously with, or within 30 days after, the filing of a notice of claim, contractor shall submit the written claim to the procurement officer. If contractor so requests, the procurement officer, on conditions the procurement officer deems satisfactory to the unit, may extend the time in which contractor must submit the claim. An example of when a procurement officer may grant an extension includes situations in which the procurement officer finds that a contemporaneous or timely cost quantification following the filing of the notice of claim is impossible or impractical.

f. The claim shall set forth all the facts surrounding the controversy. Contractor, at the discretion of the procurement officer, may be afforded an opportunity to be heard and to offer evidence in support of the claim.

g. The procurement officer shall mail or deliver written notification of the final decision within:

(1) 90 days after the procurement officer receives the claim if the claim is an amount for which the Appeals Board accelerated procedure, set forth in COMAR 21.10.06.12, may be used;

(2) 180 days after the procurement officer receives the claim for a claim not covered under §G(1) of this regulation; or

(3) A longer period that the procurement officer and contractor agree to in writing.

h. The final decision may award a contract claim only for those expenses incurred not more than 30 days before contractor was initially required to have filed the notice of claim.

i. The procurement officer's decision is the final action of the University. If the procurement officer fails to render a final decision within the time required, contractor may deem the failure to be a final decision not to pay the claim.

j. If the final decision grants the claim in part and denies the claim in part, the University shall pay contractor the undisputed amount. Payment of the partial claim is not an admission of liability by the University and does not preclude the University from recovering the amount paid if a subsequent determination modifies the final decision.

k. Contractor may file a written appeal with the Maryland State Board of Contract Appeals within 30 days of receipt of notice of the decision.
1. Pending resolution of a claim, contractor shall proceed diligently with the performance of the contract in accordance with the procurement officer’s decision.

28. Dissemination of Information
a. During the term of the contract, the Contractor shall not release any information related to the services or performance of the services under the contract nor publish any final reports or documents without the prior written approval of the University.

b. The Contractor shall indemnify and hold harmless the State and the University, its officers, agents and employees, from all liability which may be incurred by reason of dissemination, publication, distribution or circulation, in any manner whatsoever, of any information, data, documents, or materials pertaining in any way to the contract by the Contractor, its agents or employees.

29. EPA Compliance
Materials, supplies, equipment and services shall comply in all respects with the federal Noise Control Act of 1972, where applicable. Power equipment, to the greatest extent possible, shall be the quietest available. Equipment certified by the US EPA as a Low Noise Emission Product pursuant to the Federal Noise Control Act of 1972 shall be considered to meet the intent of the regulation.

The Contractor must supply and have immediately available to their employees spill containment equipment/supplies necessary to contain any hazards it may introduce to the job site. The Contractor is responsible for any and all costs incurred by the University in remediating spills or releases of materials introduced onto the job site.

Depending on the nature of the contract, the additional environmental and safety provisions contained in Exhibit A-1 may also be required.

30. FERPA
The Parties agree to maintain the privacy and security of personally identifiable educational records and health information and to prevent disclosure in compliance with Federal laws.

The Contractor agrees that in performing its obligations under this contract, the Contractor shall comply with all requirements of a non-affiliated third-party who receives a financial institution’s consumer or customer information, under the Gramm-Leach-Bliley Act of 1999 and applicable regulations thereto (the “GLB Act”) and other applicable federal and state consumer privacy acts, rules and regulations. Nonpublic personal information shall have the same meaning as that term is defined in the GLB Act.

a. The Contractor agrees to disclose such nonpublic personal information for the sole purpose of facilitating the Contractor’s performance of its duties and obligations under the contract and will not disclose such nonpublic personal information to any other party unless such disclosure is (i) allowed by the GLB Act and consented to by the University, or (ii) compelled by law, in which case the Contractor will provide notice of such disclosure to the University.

b. The Contractor represents and warrants that it will, for so long as it retains nonpublic personal information, implement and maintain in place the necessary information security policies and procedures for (i) protecting the confidentiality of such nonpublic personal information, (ii) protecting against any anticipated threats or hazards to the security or integrity of such nonpublic personal information, and (iii) protecting against the unauthorized access to or use of such nonpublic personal information. These terms apply to all subcontractors employed by the Contractor who perform work under the scope of the agreement.

If the Contractor’s price includes the cost of Contractor furnishing any other material, equipment, supplies, or other items in connection with the Contract, the Contractor shall pay the Maryland sales tax.

32. Incorporation by Reference
The terms of this solicitation and any amendments thereto are made a part of this Contract.

33. Indemnification
The University shall not assume any obligation to indemnify, hold harmless, or pay attorneys’ fees that may arise from or in any way be associated with the performance or operation of this agreement.

34. Inspection by the University
The University may provide for inspection, at any time, of any part of the Contractor’s work, and of any of the materials, supplies or equipment which the Contractor may have on hand or in the building. The Contractor shall provide adequate cooperation with any inspector assigned by the University to permit the inspector to determine the Contractor’s conformity with these specifications and the adequacy of the work being performed.

35. Intellectual Property
Contractor agrees to indemnify and save harmless the University, its officers, agents and employees with respect to any claim, action, cost or judgment for patent infringement, or trademark or copyright violation arising out of purchase or use of materials, supplies, equipment or services covered by the contract.

36. I-9 Requirement
Contractor warrants and represents that it is currently in compliance, and that during the term of the contract it will remain in compliance, with the Immigration Reform and Control Act of 1986, and that it will obtain original valid employment verification documentation from all its employees on a timely basis as required by law and regulation. This requirement also applies to all subcontractors hired by Contractor.

37. Insurance and Indemnification Provisions
a. The Contractor shall defend, indemnify and save harmless the University System of Maryland, its officers, employees and agents, from any and all claims, liability, losses and causes of actions which may arise out of the performance by the Contractor, employees or agents, of the work covered by the contract.

b. The Contractor shall secure, pay the premiums for, and keep in force until the expiration of the contract, and any renewal thereof, adequate insurance as provided below, such insurance to specifically include liability assumed by the Contractor under the contract.

(1) Commercial General Liability Insurance including all extensions
   - $2,000,000 each occurrence;
   - $2,000,000 personal injury;
   - $2,000,000 products/completed operations;
   - $2,000,000 general aggregate

(2) Workmen’s Compensation Insurance and Unemployment Insurance as required by the laws of the State of Maryland.

(3) Owner’s, Landlord’s and Tenant’s and Contractor’s bodily injury liability insurance, with limits of not less than $500,000 for each person and $2,000,000 for each accident.

(4) Property damage liability insurance with a limit of not less than $2,000,000 for each accident.

(5) If automotive equipment is used in the operation, automobile bodily injury liability insurance with limits of not less than $1,000,000 for each person and $2,000,000 for each accident, and property damage liability insurance, with a limit of not less than $2,000,000 for each accident.

c. Each policy for liability protection, bodily injury or property damage must specifically name, on its face, the University System of Maryland as an additional named insured as respects operations under the contract and premises occupied by the Contractor provided, however,
with respect to the Contractor’s liability for bodily injury or property damage under items b(1) b(6) above, such insurance shall cover and not exclude Contractor’s liability for injury to the property of the University System and to the persons or property of employees, students, faculty members, agents, officers, regents, invitees or guests of the University System.

d. Each insurance policy shall contain the following endorsements:
   “It is understood and agreed that the Insurance Company shall notify in writing procurement officer forty-five (45) days in advance of the effective date of any reduction in or cancellation of this policy.” A certificate of each policy of insurance shall be furnished to the procurement officer. With the exception of Workmen’s Compensation, upon the request of the procurement officer, a certified true copy of each policy of insurance, including the above endorsement, manually countersigned by an authorized representative of the insurance company, shall be furnished to the procurement officer. A certificate of insurance for Workmen’s Compensation together with a properly executed endorsement for cancellation notice shall also be furnished. Following the notice of contract award, the requested certificates and policies shall be delivered as directed by the procurement officer. Notices of policy changes shall be furnished to the procurement officer.

e. All required insurance coverages must be acquired from insurers authorized to do business in the State of Maryland and acceptable to the University. The insurers must have a policyholders’ rating of “A-” or better, and a financial size of “Class VII” or better in the latest edition of Best’s Insurance Reports.

38. Fire and Extended Coverage Insurance
   a. Contractor shall carry, at its own expense, builder’s risk insurance for the full contract amount, insuring against the perils of fire, lightning, extended coverage vandalism, and malicious mischief subject only to the minimum standard deductible currently filed by the Insurance Service Office with the State of Maryland Insurance Department. The University will provide no coverage during the construction period.

   b. The builder’s risk policy shall contain endorsements reading as follows:
      (1) It is the intent of this insurance to cover specifically all the Work being done under the Contract between the insureds, and as to such Work this policy shall be primary insurance and shall not contribute or claim contribution from any other insurance being carried which, by its terms, would also cover the property covered hereunder in the absence of this insurance.

      (2) Coverage afforded under this policy will not be canceled until at least fifteen (15) days prior written notice has been given to the Procurement Officer.

   c. Certificates of insurance shall be submitted to the Procurement Officer for review and approval prior to commencement of work, and shall be held for the duration of the contract. The University shall have the absolute right to terminate the contract if the policy of insurance is canceled at any time for any reason and a new policy is not obtained by Contractor and approved by the Procurement Officer.

   d. The above insurance shall remain in full force and effect until such time as the University shall fully accept the work covered by this contract.

39. Liquidated Damage
   Time is an essential element of the contract and it is important that the work be vigorously prosecuted until completion.

   For each day that any work shall remain uncompleted beyond the time(s) specified elsewhere in the contract, the Contractor shall be liable for liquidated damages in the amount(s) provided for in the solicitation, provided, however, that due account shall be taken of any adjustment of specified completion time(s) for completion of work as granted by approved change orders.

40. Local Conditions Covering Work
   The Contractor shall cooperate with those in authority on the premises to prevent the entrance and exit of all workmen and/or others whose presence is forbidden or undesirable and in bringing, storing or removal of all materials and equipment, to observe all rules and regulations in force on the grounds, to avoid unnecessary dust or accumulated debris or the undue interference with the convenience, sanitation or routine of the University and to prevent the loss of, or damage to the property of the University and/or its employees. The Contractor shall repair any and all damage he may cause to the building or property, to the full satisfaction of the University.

41. Mandated Contractor Reporting of Suspected Child Abuse & Neglect
   Maryland law contains mandatory reporting requirements for all individuals who suspect child abuse or neglect. Contractors performing work on campus also must comply with USM Board of Regents (BOR) VI-1.50 – Policy on the Reporting of Suspected Child Abuse & Neglect, as well as the University Procedures for Reporting Suspected Child Abuse and Neglect. The above-referenced USM/University Policy and Procedures are available in full at the following link: https://inside.towson.edu/generalcampus/tupolicies/documents/06-01.50%20Policy%20on%20the%20Reporting%20of%20Suspected%20Child%20Abuse%20and%20Neglect.pdf, and are incorporated herein. The University reserves the right to terminate the contract if Contractor fails to comply with the above-referenced policy or procedures, or if, in the judgment of the University, termination is necessary to protect the safety and welfare of children who come into contact with the University community.

42. Maryland Law Prevails
   The contract shall be governed by the laws of the State of Maryland. The parties agree that exclusive jurisdiction shall reside with the state and federal courts in the State of Maryland.

43. Non-Hiring of Employees
   No employee of the State of Maryland, or any department, commission, agency or branch thereof whose duties as such employee include matters relating to or affecting the subject matter of the contract, shall, while so employed, become or be an employee of the party or parties hereby contracting with the State or any department, commission, agency or branch thereof.

44. Non-Discrimination
   The Contractor will comply with all applicable Federal and State laws, rules and regulations involving non-discrimination on the basis of race, color, creed, religion, national origin, age, sex, political affiliation, marital status, veteran status, condition of disability, or other non-merit factor. In addition, Towson University’s policies, programs, and activities comply with federal and state laws and University System of Maryland regulations prohibiting discrimination on the basis of race, color, religion, age, national origin, sex, disability, and sexual orientation. Provisions for reasonable accommodations shall be made by the Contractor for handicapped applicants and qualified handicapped individuals.

45. Non-Visual Access
   The bidder or offeror warranties that the information technology offered under this bid or proposal (1) provides equivalent access for effective use by both visual and nonvisual means; (2) will present information, including prompts used for interactive communications, in formats intended for both visual and nonvisual use; (3) if intended for use in a network, can be integrated into networks for obtaining, retrieving, and disseminating information used by individuals who are not blind or visually impaired; and (4) is available, whenever possible, without modification for compatibility with software and hardware for nonvisual access. The bidder or offeror further warrants that the costs, if any, of modifying the information technology for compatibility with software and hardware used for nonvisual access will not increase the cost of the information technology by more than 5 percent.

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46. Ownership of Documents and Materials
The Contractor agrees that all documents and materials including, but not limited to, reports, drawings, studies, specifications, estimates, maps, photographs, designs, graphics, mechanical, artwork, and computations prepared by or for it under the terms of the contract shall at any time during the performance of the services be made available to the University upon request by the University and shall become and remain the exclusive property of the University upon termination or completion of the services. The University shall have the right to use same without restriction or limitation and without compensation to the Contractor other than that provided by the contract. The University shall be the owner for purposes of copyright, patent or trademark registration.

47. Patents, Copyrights and Trade Secrets
a. If the Contractor furnishes any design, device, material, process or other item which is covered by a patent or copyright or which is proprietary to or a trade secret of another, Contractor shall obtain the necessary permission or license to use such item.

b. The Contractor will defend or settle, at its own expense, any claim or suit against the State alleging that any such item furnished by Contractor infringes any patent, trademark, copyright, or trade secret. Contractor also will pay all damages and costs that by final judgment may be assessed against the State due to such infringement and all attorneys’ fees and litigation expenses reasonably incurred by the State to defend against such a claim or suit. The obligations of this paragraph are in addition to those stated in paragraph c.

c. If any products furnished by Contractor become, or in Contractor’s opinion are likely to become, the subject of a claim of infringement, Contractor will, at its option: (1) procure for the State the right to continue using the applicable item; (2) replace the product with a non-infringing product substantially complying with the item’s specifications; or (3) modify the item so it becomes non-infringing and performs in a substantially similar manner to the original item.

48. Payment Bond
A payment bond is required for all construction contracts in excess of $100,000 in the amount equal to at least 100 percent of the contract price. The payment bond shall be delivered by the contractor to the State not later than the time the contract is executed. If a contractor fails to deliver the required payment bond, the contractor’s bid shall be rejected, its bid security shall be enforced, and award of the contract shall be made to the next lowest responsive and responsible bidder.

The required payment bond shall be in the State of Maryland form in effect at the time the contract is executed per COMAR 21.07.02.10B.

49. Performance Bond
A performance bond is required for all construction contracts in excess of $100,000 in the amount equal to at least 100 percent of the contract price. The performance bond shall be delivered by the contractor to the University not later than the time the contract is executed. If a contractor fails to deliver the required performance bond, the contractor’s bid shall be rejected, its bid security shall be enforced, and award of the contract may be made to the next lowest responsive and responsible bidder.

The required performance bond shall be in the State of Maryland form in effect at the time the contract is executed per COMAR 21.07.02.10A.

50. Payment of State Obligations
Payments to the Contractor pursuant to this contract shall be made no later than 30 days after the University’s receipt of a proper invoice from the Contractor. Charges of late payment of invoices, other than as prescribed by Title 15, subtitle 1, of the State Finance and Procurement Article, Annotated Code of Maryland, or by the Public Service Commission of Maryland with respect to regulated public utilities, as applicable, are prohibited.

51. Policies and Procedures
The USM Procurement Policies and Procedures in effect on the date of execution of this Contract are applicable to this Contract.

52. Responsibility of Contractor
a. The Contractor shall perform the services with that standard of care, skill, and diligence normally provided by a Contractor in the performance of services similar to the services hereunder.

b. Notwithstanding any review, approval, acceptance or payment for the services by the University, the Contractor shall be responsible for professional and technical accuracy of its work, design drawings, specifications and other materials furnished by the Contractor under the contract.

53. Prompt Payment of Subcontractors
a. This contract and all subcontracts issued under this contract are subject to the provisions of State Finance and Procurement Article, §15-226, Annotated Code of Maryland. References to “undisputed amount”, “prime contractor”, “contractor” and “subcontractor” have the meanings stated in Section 6.2 a-d herein have the meanings stated in COMAR 21.10.08.01.

b. A contractor shall promptly pay its subcontractors an undisputed amount to which a subcontractor is entitled for work performed under this contract within 10 calendar days after the contractor receives a progress payment or final payment for work under this contract.

c. If a contractor fails to make payment within the period prescribed in b., a subcontractor may request a remedy in accordance with COMAR 21.10.08.

d. A contractor shall include in its subcontracts for work under the contract, wording that incorporates the provisions, duties, and obligations of 6.1 a-d: State Finance and Procurement Article, §15-226, Annotated Code of Maryland; and COMAR 21.10.08.

54. Responsibility for Claims and Liability
The Contractor shall be responsible for all damage to life and property due to its activities or those of its agents or employees, in connection with the services required under the contract. Further, it is expressly understood that the Contractor shall indemnify and save harmless the University, its officers, agents, and employees from and against all claims, suits, judgments, expenses, actions, damages and costs of every name and description, including reasonable attorney’s fees and litigation expenses arising out of or resulting from the negligent performance of the services of the Contractor under the contract.

55. Responsibility for Damage
a. The Contractor shall repair and restore to its original condition any equipment, materials or surfaces damaged by its operations.

b. The Contractor shall be entirely responsible for any loss or damage to its own materials, supplies, and equipment, and to the personal property of its employees while they are in the building.

c. The Contractor shall be solely responsible for any damage to the building or its contents for any loss or damage to any property belonging to the University or the University employees when such loss or damage may be attributable to their actions or negligence or the actions or negligence of their employees.
56. Retainage
   a. This section shall apply if the contractor has furnished 100 percent payment security and 100 percent performance security. The contractor and each subcontractor at any tier shall incorporate the mandatory provisions outlined below in paragraphs b. through d. of this section, into each subcontract for work related to this contract.
   b. The contractor may not retain from any payment due a subcontractor a percent of the payment greater than the percent for retainage specified in the contract.
   c. A subcontractor at any tier may not retain from any payment due a lower tier subcontractor a percent of the payment greater than the percent of payments retained from the subcontractor.
   d. A contractor and a subcontractor are not prohibited, by this section from withholding an amount in addition to retainage if the contractor or subcontractor determines that a subcontractor’s performance under the subcontract provides reasonable grounds for withholding an additional amount.

57. Retention of Records
   The Contractor shall retain and maintain all records and documents relating to the contract for a minimum period of four years after payment by the University of the final invoice and shall make them available for inspection and audit by the State of Maryland.

58. Set-Off
   The University may deduct from and set off against any amounts due and payable to the Contractor any back-charges or damages sustained by the University by virtue of any breach of the contract by the Contractor or by virtue of the failure or refusal of the Contractor to perform the services or any part of the services in a satisfactory manner. Nothing herein shall be construed to relieve the Contractor of liability for additional costs resulting from a failure to satisfactorily perform the services.

59. Site Investigation
   The Contractor acknowledges that he has investigated and satisfied himself as to the conditions affecting the work, including but not restricted to those bearing upon transportation, disposal, handling and storage of materials, availability of labor, water, electric power, roads and uncertainties of weather, river stages, tides or similar physical conditions at the site, the conformation and conditions of the ground, the character of equipment and facilities needed preliminary to and during prosecution of the work. The Contractor further acknowledges that he has satisfied himself as to the character, quality and quantity of surface and subsurface materials or obstacles to be encountered insofar as this information is reasonably ascertainable from an inspection of the site, including all exploratory work done by the University, as well as from information presented by the drawings and specifications made a part of this contract. Any failure by the Contractor to acquaint himself with the available information may not relieve him from responsibility for estimating properly the difficulty or cost of successfully performing the work. The University assumes no responsibility for any conclusions or interpretations made by the Contractor on the basis of the information made available by the University.

60. Software Contracts:
   As specifically provided by § 21-104, Commercial Law Article, Annotated Code of Maryland, the parties agree that this Agreement shall not be governed by the Uniform Computer Information Transactions Act (UCITA), Title 21 of the Commercial Law Article of the Annotated Code of Maryland, as amended from time to time. This Agreement shall be governed by the common law of Maryland relating to written agreements, as well as other statutory provisions, other than UCITA, which may apply, and shall be interpreted and enforced as if UCITA had never been adopted in Maryland.

   Contractor agrees that as delivered to buyer, the software does not contain any program code, virus, worm, trap door, back door, timer or clock that would erase data or programming or otherwise cause the software to become inoperable, inaccessible, or incapable of being used in accordance with its user manuals, either automatically upon the occurrence of selected conditions, or manually on command of Contractor.

61. Specifications
   All materials, equipment, supplies or services shall conform to Federal and State laws and regulations and to the specifications contained in the solicitation. No asbestos, lead, or PCB-containing materials (0%) are to be utilized/installed on campus unless prior written approval has been received from the University’s Department of Environmental Health & Safety (410-704-2949).

62. Subcontracting or Assignment
   The benefits and obligations hereunder shall take effect and be binding upon the parties hereto and neither the contract nor the services to be performed thereunder shall be subcontracted, or assigned or otherwise disposed of, either in whole or in part, except with the prior written consent of the University.

63. Suspension of Work
   The procurement officer unilaterally may order the Contractor in writing to suspend, delay, or interrupt all or any part of the work for such period of time as he may determine to be appropriate for the convenience of the University.

64. Tax Exemption
   The State is generally exempt from federal excise taxes, Maryland sales and use taxes, District of Columbia sales taxes, and transportation taxes. Exemption certificates shall be provided upon request. Where a Contractor is required to furnish and install material in the construction of improvement to real property in performance of the Contract, the Contractor shall pay the Maryland sales tax and the exemption does not apply.

65. Termination of Contract for Default
   If the Contractor fails to fulfill its obligation under the contract properly and on time, or otherwise violates any provision of the contract, the University may terminate the contract by written notice to the Contractor. The notice shall specify the acts or omissions relied on as cause for termination. All finished or unfinished services provided by the Contractor shall, at the University’s option, become the University’s property. The University shall pay the Contractor fair and equitable compensation for satisfactory performance prior to receipt of notice of termination, less the amount of damages caused by the Contractor’s breach. If the damages are more than the compensation payable to the Contractor, the Contractor will remain liable after termination and the University can affirmatively collect damages. The term “damages” as used in this paragraph may include attorney’s fees and litigation costs. Termination hereunder, including the determination of the rights and obligations of the parties, shall be governed by the provisions of USM Procurement Policies and Procedures.

66. Termination of Contract for Convenience
   The performance of work under the contract may be terminated by the University in accordance with this clause in whole, or from time to time in part, whenever the University shall determine that such termination is in the best interest of the University. The University will pay all reasonable costs associated with the contract that the Contractor has incurred up to the date of termination and all reasonable costs associated with termination of the contract. However, the Contractor shall not be reimbursed for any anticipatory profits which have not been earned up to the date of termination. Termination hereunder, including the determination of the rights and obligations of the parties, shall be governed by the provisions of USM Procurement Policies and Procedures.
67. Termination of Multi-Year Contracts
If the General Assembly fails to appropriate funds or if funds are not otherwise made available for continued performance for any fiscal period of the contract succeeding the first fiscal period, the contract shall be canceled automatically as of the beginning of the fiscal year for which funds were not appropriated or otherwise made available; provided, however, that this will not affect either the State's rights or the Contractor's rights under any termination clause in the contract. The effect of termination of the contract hereunder will be to discharge both the Contractor and the State from future performance of the contract, but not from their rights and obligations existing at the time of termination. The Contractor shall be reimbursed for the reasonable value of any non-recurring costs incurred but not amortized in the price of the contract. The State will notify the Contractor as soon as it has knowledge that funds may not be available for the continuation of the contract for each succeeding fiscal period beyond the first.

68. Truth-In-Negotiation Certification
The Contractor by submitting cost or price information, including wage rates or other factual unit costs, certifies to the best of its knowledge, information and belief, that:

a. The wage rates and other factual unit costs supporting the firm's compensation, as set forth in the proposal, are accurate, complete and current as of the contract date;

b. If any of the items of compensation were increased due to the furnishing of inaccurate, incomplete or noncurrent wage rates or other units of costs, the State is entitled to an adjustment in all appropriate items of compensation, including profit or fee, to exclude any significant sum by which the price was increased because of the defective data. The State's right to adjustment includes the right to a price adjustment for defects in costs or pricing data submitted by a prospective or actual subcontractor; and

c. If additions are made to the original price of the contract, such additions may be adjusted to exclude any significant sums where it is determined the price has been increased due to inaccurate, incomplete or noncurrent wage rates and other factual costs."

69. Use of Contractor's Forms Not Binding on State
a. Except as provided in b., the use or execution by the State of any forms, orders, agreements, or other documents of any kind, other than the contract documents, used pursuant to or in the administration of any contract awarded by the State to Contractor, shall not bind the State to any of the terms and conditions contained therein except those provisions:

1. generally describing, for the purposes of ordering: Equipment or services to be provided, locations, quantities, delivery or installation dates, and, to the extent consistent with the contract documents, prices; and

2. not otherwise inconsistent with the contract documents.

b. Any such form, order, agreement or other document shall not vary, modify, or amend the terms and provisions of the contract documents, notwithstanding any provision to the contrary in such document, unless all of the following conditions are met:

1. the document expressly refers to the particular document and provision of the contract documents being modified and plainly and conspicuously identifies any modification thereto as a modification:

2. the document is executed on behalf of the State by the procurement officer; and

3. execution of the document is approved by the procurement authority whose approval is required by law.

70. Variations in Estimated Quantities
Where the quantity of a pay item in this contract is an estimated quantity and where the actual quantity of such pay item varies more than twenty-five percent (25%) above or below the estimated quantity stated in this contract, an equitable adjustment in the contract price shall be made upon demand of either party. The equitable adjustment shall be based upon any increase or decrease in costs due solely to the variation above one hundred twenty-five percent (125%) or below seventy-five percent (75%) of the estimated quantity. If the quantity variation is such as to cause an increase in the time necessary for completion, the procurement officer shall, upon receipt of a written request for an extension of time within ten (10) days from the beginning of the delay, or within a further period of time which may be granted by the procurement officer before the date of final settlement of the contract, ascertain the facts and make the adjustment for extending the completion date as in his judgment the findings justify.
EXHIBIT B
BID/PROPOSAL AFFIDAVIT

A. AUTHORITY

I HEREBY AFFIRM THAT:

I am the (title) and the duly authorized representative of (business) and that I possess the legal authority to make this Affidavit on behalf of myself and the business for which I am acting.

B. AFFIRMATION REGARDING BRIBERY CONVICTIONS

I FURTHER AFFIRM THAT: Neither I, nor to the best of my knowledge, information, and belief, the above business (as is defined in Section 16-101(b) of the State Finance and Procurement Article of the Annotated Code of Maryland), or any of its officers, directors, partners, controlling stockholders, or any of its employees directly involved in the business's contracting activities including obtaining or performing contracts with public bodies has been convicted of, or has had probation before judgment imposed pursuant to Criminal Procedure Article, §6-220, Annotated Code of Maryland, or has pleaded nolo contendere to a charge of, bribery, attempted bribery, or conspiracy to bribe in violation of Maryland law, or of the law of any other state or federal law, except as follows (indicate the reasons why the affirmation cannot be given and list any conviction, plea, or imposition of probation before judgment with the date, court, official or administrative body, the sentence or disposition, the name(s) of person(s) involved, and current positions and responsibilities with the business):

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

C. AFFIRMATION REGARDING OTHER CONVICTIONS RETAINED

I FURTHER AFFIRM THAT: Neither I, nor to the best of my knowledge, information, and belief, the above business, or any of its officers, directors, partners, controlling stockholders, or any of its employees directly involved in the business's contracting activities including obtaining or performing contracts with public bodies, has:

(1) Been convicted under state or federal statute of:
   (a) A criminal offense incident to obtaining, attempting to obtain, or performing a public or private contract; or
   (b) Fraud, embezzlement, theft, forgery, falsification or destruction of records or receiving stolen property;

(2) Been convicted of any criminal violation of a state or federal antitrust statute;

(3) Been convicted under the provisions of Title 18 of the United States Code for violation of the Racketeer Influenced and Corrupt Organization Act, 18 U.S.C. §1961 et seq., or the Mail Fraud Act, 18 U.S.C. §1341 et seq., for acts in connection with the submission of bids or proposals for a public or private contract;

(4) Been convicted of a violation of the State Minority Business Enterprise Law, §14-308 of the State Finance and Procurement Article of the Annotated Code of Maryland;
(5) Been convicted of a violation of §11-205.1 of the State Finance and Procurement Article of the Annotated Code of Maryland;

(6) Been convicted of conspiracy to commit any act or omission that would constitute grounds for conviction or liability under any law or statute described in subsections (1) - (5) above;

(7) Been found civilly liable under a state or federal antitrust statute for acts or omissions in connection with the submission of bids or proposals for a public or private contract;

(8) Been found in a final adjudicated decision to have violated the Commercial Nondiscrimination Policy under Title 19 of the State Finance and Procurement Article of the Annotated Code of Maryland with regard to a public or private contract; or

(9) Admitted in writing or under oath, during the course of an official investigation or other proceedings, acts or omissions that would constitute grounds for conviction or liability under any law or statute described in §§B and C and subsections D(1)—(8) above, except as follows (indicate reasons why the affirmations cannot be given, and list any conviction, plea, or imposition of probation before judgment with the date, court, official or administrative body, the sentence or disposition, the name(s) of the person(s) involved and their current positions and responsibilities with the business, and the status of any debarment):

D. AFFIRMATION REGARDING DEBARMENT

I FURTHER AFFIRM THAT: Neither I, nor to the best of my knowledge, information, and belief, the above business, or any of its officers, directors, partners, controlling stockholders, or any of its employees directly involved in the business's contracting activities, including obtaining or performing contracts with public bodies, has ever been suspended or debarred (including being issued a limited denial of participation) by any public entity, except as follows (list each debarment or suspension providing the dates of the suspension or debarment, the name of the public entity and the status of the proceedings, the name(s) of the person(s) involved and their current positions and responsibilities with the business, the grounds of the debarment or suspension, and the details of each person's involvement in any activity that formed the grounds of the debarment or suspension):

E. AFFIRMATION REGARDING DEBARMENT OF RELATED ENTITIES

I FURTHER AFFIRM THAT:

(1) The business was not established and it does not operate in a manner designed to evade the application of or defeat the purpose of debarment pursuant to Sections 16-101, et seq., of the State Finance and Procurement Article of the Annotated Code of Maryland; and
(2) The business is not a successor, assignee, subsidiary, or affiliate of a suspended or debarred business, except as follows (indicate reasons why the affirmations cannot be given without qualification):


F. SUB-CONTRACT AFFIRMATION

I FURTHER AFFIRM THAT: Neither I, nor to the best of my knowledge, information, and belief, the above business, has knowingly entered into a contract with a public body under which a person debarred or suspended under Title 16 of the State Finance and Procurement Article of the Annotated Code of Maryland will provide, directly or indirectly, supplies, services, architectural services, construction related services, leases of real property, or construction.

G. AFFIRMATION REGARDING COLLUSION

I FURTHER AFFIRM THAT: Neither I, nor to the best of my knowledge, information, and belief, the above business has:

(1) Agreed, conspired, connived, or colluded to produce a deceptive show of competition in the compilation of the accompanying bid or offer that is being submitted;

(2) In any manner, directly or indirectly, entered into any agreement of any kind to fix the bid price or price proposal of the bidder or offeror or of any competitor, or otherwise taken any action in restraint of free competitive bidding in connection with the contract for which the accompanying bid or offer is submitted.

H. CERTIFICATION OF TAX PAYMENT

I FURTHER AFFIRM THAT: Except as validly contested, the business has paid, or has arranged for payment of, all taxes due the State of Maryland and has filed all required returns and reports with the Comptroller of the Treasury, the State Department of Assessments and Taxation, and the Department of Labor, Licensing, and Regulation, as applicable, and will have paid all withholding taxes due the State of Maryland prior to final settlement.

I. CONTINGENT FEES

I FURTHER AFFIRM THAT: The business has not employed or retained any person, partnership, corporation, or other entity, other than a bona fide employee, bona fide agent, bona fide salesperson, or commercial selling agency working for the business, to solicit or secure the Contract, and that the business has not paid or agreed to pay any person, partnership, corporation, or other entity, other than a bona fide employee, bona fide agent, bona fide salesperson, or commercial selling agency, any fee or any other consideration contingent on making of the Contract.

J. CERTIFICATION REGARDING INVESTMENTS IN IRAN

(1) The undersigned bidder or offeror certifies that, in accordance with State Finance & Procurement Article, §17-705:

(i) it is not identified on the list created by the Board of Public Works as a person engaging in investment activities in Iran as described in §17-702 of State Finance & Procurement; and

(ii) it is not engaging in investment activities in Iran as described in State Finance & Procurement Article, §17-702.
The undersigned bidder or offeror is unable to make the above certification regarding its investment activities in Iran due to the following activities:


K. ACKNOWLEDGEMENT

I ACKNOWLEDGE THAT: This Affidavit is to be furnished to the Procurement Officer and may be distributed to units of: (1) the State of Maryland; (2) counties or other subdivisions of the State of Maryland; (3) other states; and (4) the federal government. I further acknowledge that this Affidavit is subject to applicable laws of the United States and the State of Maryland, both criminal and civil, and that nothing in this Affidavit or any contract resulting from the submission of this bid or proposal shall be construed to supersede, amend, modify or waive, on behalf of the State of Maryland, or any unit of the State of Maryland having jurisdiction, the exercise of any statutory right or remedy conferred by the Constitution and the laws of Maryland with respect to any misrepresentation made or any violation of the obligations, terms and covenants undertaken by the above business with respect to (1) this Affidavit, (2) the contract, and (3) other Affidavits comprising part of the contract.

I DO SOLEMNLY DECLARE AND AFFIRM UNDER THE PENALTIES OF PERJURY THAT THE CONTENTS OF THIS AFFIDAVIT ARE TRUE AND CORRECT TO THE BEST OF MY KNOWLEDGE, INFORMATION, AND BELIEF.

Date: __________________________

By: ____________________________

(Print Name of Authorized Representative and Affiant)

(Signature of Authorized Representative and Affiant)

(Title of Authorized Representative and Affiant)
EXHIBIT C
CONTRACT AFFIDAVIT

A. AUTHORIZED REPRESENTATIVE

I HEREBY AFFIRM THAT:

I am the ________________________________ (title) and the duly authorized representative of ________________________________ (business) and that I possess the legal authority to make this Affidavit on behalf of myself and the business for which I am acting.

B. CERTIFICATION OF CORPORATION REGISTRATION AND TAX PAYMENT OR QUALIFICATION WITH THE STATE DEPARTMENT OF ASSESSMENTS AND TAXATION

I FURTHER AFFIRM THAT: The business named above is a (X applicable items):

(1) ☐ Corporation ☐ domestic (i.e., organized in Maryland) or ☐ foreign;  
(2) ☐ Limited Liability Co. ☐ domestic or ☐ foreign;  
(3) ☐ Partnership ☐ domestic or ☐ foreign;  
(4) ☐ Statutory Trust ☐ domestic or ☐ foreign;  
(5) ☐ Sole Proprietorship 

and is registered or qualified as required under Maryland Law.

I further affirm that the above business is in good standing both in Maryland and (IF APPLICABLE) in the jurisdiction where it is presently organized, and has filed all of its annual reports, together with filing fees, with the Maryland State Department of Assessments and Taxation. The name and address of its resident agent (IF APPLICABLE) filed with the State Department of Assessments and Taxation is:

Name and Department ID Number: ________________________________

Address: ________________________________

and that if it does business under a trade name, it has filed a certificate with the State Department of Assessments and Taxation that correctly identifies that true name and address of the principal or owner as:

Name and Department ID Number: ________________________________

Address: ________________________________

C. FINANCIAL DISCLOSURE AFFIRMATION

I FURTHER AFFIRM THAT: I am aware of, and the above business will comply with, the provisions of Section 13-221 of the State Finance and Procurement Article of the Annotated Code of Maryland, which require that every business that enters into contracts, leases, or other agreements with the State of Maryland or its agencies during a calendar year under which the business is to receive in the aggregate $100,000 or more shall, within 30 days of the time when the aggregate value of the contracts, leases, or other agreements reaches $100,000, file with the Secretary of State of Maryland certain specified information to include disclosure of beneficial ownership of the business.
D. POLITICAL CONTRIBUTION DISCLOSURE AFFIRMATION

I FURTHER AFFIRM THAT: I am aware of, and the above business will comply with, Election Law Article, §§14-101 through 14-108, Annotated Code of Maryland, which requires that every person that enters into contracts, leases, or other agreements with the State of Maryland, including its agencies or a political subdivision of the State valued at $200,000 or more, shall file with the State Board of Elections a statement disclosing contributions in excess of $500 made during the reporting period to a candidate for elective office in any primary or general election.

E. DRUG AND ALCOHOL FREE WORKPLACE

I CERTIFY THAT:

(1) Terms defined in COMAR 21.11.08 shall have the same meanings when used in this certification.

(2) By submission of its bid or offer, the business, if other than an individual, certifies and agrees that, with respect to its employees to be employed under a contract resulting from this solicitation, the business shall:

   (a) Maintain a workplace free of drug and alcohol abuse during the term of the contract;

   (b) Publish a statement notifying its employees that the unlawful manufacture, distribution, dispensing, possession, or use of drugs, and the abuse of drugs or alcohol is prohibited in the business's workplace and specifying the actions that will be taken against employees for violation of these prohibitions;

   (c) Prohibit its employees from working under the influence of drugs or alcohol;

   (d) Not hire or assign to work on the contract anyone whom the business knows, or in the exercise of due diligence should know, currently abuses drugs or alcohol and is not actively engaged in a bona fide drug or alcohol abuse assistance or rehabilitation program;

   (e) Promptly inform the appropriate law enforcement agency of every drug-related crime that occurs in its workplace if the business has observed the violation or otherwise has reliable information that a violation has occurred;

   (f) Establish drug and alcohol abuse awareness programs to inform its employees about:

      (i) The dangers of drug and alcohol abuse in the workplace;

      (ii) The business's policy of maintaining a drug and alcohol free workplace;

      (iii) Any available drug and alcohol counseling, rehabilitation, and employee assistance programs; and

      (iv) The penalties that may be imposed upon employees who abuse drugs and alcohol in the workplace;

   (g) Provide all employees engaged in the performance of the contract with a copy of the statement required by §(2)(b), above;

   (h) Notify its employees in the statement required by §(2)(b) above, that as a condition of continued employment on the contract, the employee shall:

      (i) Abide by the terms of the statement; and

      (ii) Notify the employer of any criminal drug or alcohol abuse conviction for an offense occurring in the workplace not later than 5 days after a conviction;

   (i) Notify the procurement officer within 10 days after receiving notice under §(2)(h)(ii), above, or otherwise receiving actual notice of a conviction;

   (j) Within 30 days after receiving notice under §(2)(h)(ii) above, or otherwise receiving actual notice of a conviction, impose either of the following sanctions or remedial measures on any employee who is convicted of a drug or alcohol abuse offense occurring in the workplace:
(i) Take appropriate personnel action against an employee, up to and including termination; or

(ii) Require an employee to satisfactorily participate in a bona fide drug or alcohol abuse assistance or rehabilitation program; and

(k) Make a good faith effort to maintain a drug and alcohol free workplace through implementation of §(2)(a) through (j), above.

(3) If the business is an individual, the individual shall certify and agree as set forth in §(4), below, that the individual shall not engage in the unlawful manufacture, distribution, dispensing, possession, or use of drugs or the abuse of drugs or alcohol in the performance of the contract.

(4) I acknowledge and agree that:

(a) The award of the contract is conditional upon compliance with COMAR 21.11.08 and this certification;

(b) The violation of the provisions of COMAR 21.11.08 or this certification shall be cause to suspend payments under, or terminate the contract for default under COMAR 21.07.01.11 or 21.07.03.15, as applicable; and

(c) The violation of the provisions of COMAR 21.11.08 or this certification in connection with the contract may, in the exercise of the discretion of the Board of Public Works, result in suspension and debarment of the business under COMAR 21.08.03.

F. CERTAIN AFFIRMATIONS VALID

I FURTHER AFFIRM THAT:

To the best of my knowledge, information, and belief, each of the affirmations, certifications, or acknowledgments contained in that certain Bid/Proposal Affidavit dated __________, 20 ___ and executed by me for the purpose of obtaining the contract to which this Exhibit is attached remains true and correct in all respects as if made as of the date of this Contract Affidavit and as if fully set forth herein.

I DO SOLEMNLY DECLARE AND AFFIRM UNDER THE PENALTIES OF PERJURY THAT THE CONTENTS OF THIS AFFIDAVIT ARE TRUE AND CORRECT TO THE BEST OF MY KNOWLEDGE, INFORMATION, AND BELIEF.

DATE: __________________________

BY: ______________________________

(Printed Name and Title of Authorized Representative and Affiant)

(Signature of Authorized Representative and Affiant)
EXHIBIT D
SAMPLE AGREEMENT

This Agreement made the _________ day of __________________________, Two Thousand and ____, by and between _________________________, herein called "Contractor" and Towson University, herein called "University."Witnesseth, that the Contractor and the University, for the consideration here mentioned agree as follows:

Article 1. Scope of Contract - The Contractor shall furnish all materials and perform all of the work described in the Contract Documents, and shall comply with all of the terms and conditions of the Contract Documents, all of which are made a part hereof and are referred to herein as "the Contract."

Article 2. Contract Documents - The Contract between the parties is set forth in the Contract Documents which consist of the following, listed in their order of precedence:
   A. This Contract,
   B. Towson University - Request for Proposal, for the Procurement of ____________________________, including all attachments, exhibits, and addenda, and subsequent Purchase Order, and
   C. Contractor's Proposal dated ______________, submitted in response to the RFP (hereinafter referred to as the "Proposal").

In the event of a conflict between the terms and conditions of any of the Contract Documents, the controlling terms and conditions shall be in the above listed order of precedence.

Article 3. Services - The Contractor's performance under this Contract shall be in accordance with the requirements generally set forth in the RFP and specifically described in Section V., Specifications and as set forth in the Contractor's Technical Proposal.

Article 4. Term of Contract – The term of the contract shall be one year from the date that the University provides the Contractor with a Notice to Proceed. The University shall have the option to exercise four annual renewal options, said options to be exercised at the sole discretion of the University. Should the University elect to renew the contract, all prices, terms and conditions will remain in effect.

Article 5. Contract Price - The University shall pay the Contractors as follows:

Total Project Cost $ _______________

Article 6. Payment of State Obligations - Contractor will be paid for services rendered in accordance with the terms and conditions of the Contract Documents and upon submission of proper invoices submitted to the Towson University, Accounts Payable Office. The Contractor's Federal Identification Number and the University's Purchase Order number must be included on all invoices. Towson University is exempt from the payment of taxes and shall provide the Contractor with a copy of tax-exempt certificate upon request.
Electronic funds will be used by the State to pay Contractor for this Contract and any other State payments due Contractor unless the State Comptroller’s Office grants Contractor an exemption.

Electronic funds will be used by the State to pay Contractor for this Contract and any other State payments due Contractor unless the State Comptroller’s Office grants Contractor an exemption.

Article 7. Limitation of Liability - The University shall not be liable for any indirect, special or consequential damages, such as loss of anticipated profits or other economic loss in connection with or arising out of the services provided in the Contract.

Article 8. Assignment - University may assign this Contract with Contractor’s written consent, which shall not be unreasonably withheld.

Article 9. Entire Agreement - This Contract, including all Contract Documents, constitutes the entire agreement between the University and the Contractor. No waiver, modification or amendment of any of the terms or conditions hereof shall be effective unless set forth in writing and duly signed by the Contractor and the University.

IN WITNESS WHEREOF, the parties have executed this Contract by their duly authorized officer, agents or official on the day and year first above written.

CONTRACTOR

Witness  Corporate Officer or Authorized Agent  Date

Printed Name and Title

TOWSON UNIVERSITY

Witness  Authorized Agent  Date

Printed Name and Title
EXHIBIT E

MINORITY BUSINESS ENTERPRISE (MBE) PARTICIPATION
1. Contractor shall structure its procedures for the performance of the work required in this Contract to attempt to achieve the minority business enterprise (MBE) subcontractor participation goal stated in the Invitation for Bids or Request for Proposals. Contractor agrees to exercise good faith efforts to carry out the requirements set forth in these Instructions, as authorized by the Code of Maryland Regulations (COMAR) 21.11.03.

2. MBE Goals and Subgoals: Please review the solicitation for information regarding the Contract’s MBE overall participation goals and subgoals. After satisfying the requirements for any established subgoals, the Contractor is encouraged to use a diverse group of subcontractors and suppliers from the various MBE classifications to meet the remainder of the overall MBE participation goal.

3. MBE means a minority business enterprise that is certified by the Maryland Department of Transportation (“MDOT”). Only MBEs certified by MDOT may be counted for purposes of achieving the MBE participation goals. In order to be counted for purposes of achieving the MBE participation goals, the MBE firm, including a MBE prime, must be MDOT-certified for the services, materials or supplies that it is committed to perform on the MBE Participation Schedule. A firm whose MBE certification application is pending may not be counted.

4. Please refer to the MDOT MBE Directory at https://mbe.mdot.maryland.gov/directory/ to determine if a firm is certified with the appropriate North American Industry Classification System (“NAICS”) code and the product/services description (specific product that a firm is certified to provide or specific areas of work that a firm is certified to perform). For more general information about NAICS codes, please visit https://www.census.gov/eos/www/naics/. Only those specific products and/or services for which a firm is certified in the MDOT Directory can be used for purposes of achieving the MBE participation goals. CAUTION: If the firm’s NAICS code is in graduated status, such services/products may not be counted for purposes of achieving the MBE participation goals. A NAICS code is in the graduated status if the term “Graduated” follows the code in the MDOT MBE Directory.

5. Guidelines Regarding MBE Prime Self-Performance. Please note that when a certified MBE firm participates as a prime contractor on a Contract, a procurement agency may count the distinct, clearly defined portion of the work of the Contract that the certified MBE firm performs with its own workforce toward fulfilling up to, but no more than, fifty-percent (50%) of the overall MBE participation goal, including up to one hundred percent (100%) of not more than one of the MBE participation subgoals, if any, established for the Contract.
✓ In order to receive credit for self-performance, an MBE prime must be certified in the appropriate NAICS code to do the work and must list its firm in the MBE Participation Schedule, including the certification category under which the MBE prime is self-performing and include information regarding the work it will self-perform.

✓ For the remaining portion of the overall goal and the remaining subgoals, the MBE prime must also identify on the MBE Participation Schedule the other certified MBE subcontractors used to meet those goals or request a waiver.

✓ These guidelines apply to the work performed by the MBE Prime that can be counted for purposes of meeting the MBE participation goals. These requirements do not affect the MBE Prime’s ability to self-perform a greater portion of the work in excess of what is counted for purposes of meeting the MBE participation goals.

✓ Please note that the requirements to meet the MBE participation overall goal and subgoals are distinct and separate. If the contract has subgoals, regardless of MBE Prime’s ability to self-perform up to 50% of the overall goal (including up to 100% of any subgoal), the MBE Prime must either commit to use other MBEs for each of any remaining subgoals or request a waiver. As set forth in Attachment 1-B Waiver Guidance, the MBE Prime’s ability to self-perform certain portions of the work of the Contract will not be deemed a substitute for the good faith efforts to meet any remaining subgoal or the balance of the overall goal.

✓ In certain instances where the percentages allocated to MBE participation subgoals add up to more than 50% of the overall goal, the portion of self-performed work that an MBE Prime may count toward the overall goal may be limited to less than 50%. Please refer to the Governor’s Office of Small Minority & Women Business Affairs’ website for the MBE Prime Regulations Q&A for illustrative examples. http://www.goMDsmallbiz.maryland.gov/Documents/MBE_Toolkit/MBEPrimeRegulation_QA.pdf

6. Subject to items 1 through 5 above, when a certified MBE performs as a participant in a joint venture, a procurement agency may count a portion of the total dollar value of the Contract equal to the distinct, clearly-defined portion of the work of the Contract that the certified MBE performs with its own forces toward fulfilling the Contract goal, and not more than one of the Contract subgoals, if any.

7. The work performed by a certified MBE firm, including an MBE prime, can only be counted towards the MBE participation goal(s) if the MBE firm is performing a commercially useful function on the Contract. Please refer to COMAR 21.11.03.12-1 for more information regarding these requirements.
8. **Materials and Supplies: New Guidelines Regarding MBE Participation.**

- **Regular Dealer** (generally identified as a wholesaler or supplier in the MDOT Directory): Up to 60% of the costs of materials and supplies provided by a certified MBE may be counted towards the MBE participation goal(s) if such MBE is a Regular Dealer of such materials and supplies. Regular Dealer is defined as a firm that owns, operates, or maintains a store, a warehouse, or any other establishment in which the materials, supplies, articles, or equipment are of the general character described by the specifications required under the contract and are bought, kept in stock, or regularly sold or leased to the public in the usual course of business; and does not include a packager, a broker, a manufacturer’s representative, or any other person that arranges or expedites transactions.

  **Example for illustrative purposes of applying the 60% rule**
  
  Overall contract value: $2,000,000  
  Total value of supplies: $100,000

  Calculate Percentage of Supplies to overall contract value:  
  $100,000 divided by $2,000,000 = 5%  

  **Apply 60% Rule - Total percentage of Supplies/Products 5% x 60% = 3%**

  3% would be counted towards achieving the MBE Participation Goal and Subgoal, if any, for the MBE supplier in this example.

- **Manufacturer:** A certified MBE firm’s participation may be counted in full if the MBE is certified in the appropriate NAICS code(s) to provide products and services as a manufacturer.

- **Broker:** With respect to materials or supplies purchased from a certified MBE that is neither a manufacturer nor a regular dealer, a unit may apply the entire amount of fees or commissions charged for assistance in the procurement of the materials and supplies, fees, or transportation charges for the delivery of materials and supplies required on a procurement toward the MBE contract goals, provided a unit determines the fees to be reasonable and not excessive as compared with fees customarily allowed for similar services. A unit may not apply any portion of the costs of the materials and supplies toward MBE goals.

- **Furnish and Install and other Services:** The participation of a certified MBE supplier, wholesaler, and/or regular dealer certified in the proper NAICS code(s) to furnish and install materials necessary for successful contract completion may be counted in full. Includes the participation of other MBE service providers in the proper NAICS code(s) may be counted in full.

9. **Dually certified firms.** An MBE that is certified in more than one subgroup category may only be counted toward goal fulfillment of ONE of those categories with regard to a particular contract.

Example: A woman-owned Hispanic American (dually certified) firm may be used to fulfill the women-owned OR Hispanic American subgoal, but not both on the same contract.

10. **CAUTION:** The percentage of MBE participation, computed using the percentage amounts determined for all of the MBE firms listed in Part 3, MUST meet or exceed the MBE participation goal and subgoals (if applicable) as set forth in Part 2- for this solicitation. If a bidder/offeror is unable to meet the MBE participation goal or any subgoals (if applicable), then the bidder/offeror must request a waiver in Part 2 or the bid will be deemed not responsive, or the proposal not reasonably susceptible of being selected.
for award. You may wish to use the attached Goal/Subgoal Worksheet to assist in calculating the percentages and confirming that your commitment meets or exceeds the applicable MBE participation goal and subgoals (if any).

11. If you have any questions as to whether a firm is certified to perform the specific services or provide specific products, please contact MDOT’s Office of Minority Business Enterprise at 1-800-544-6056 or via email to mbe@mdot.state.md.us sufficiently prior to the submission due date.

**Subgoals (if applicable)**

<table>
<thead>
<tr>
<th>Subgoal</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total African American MBE Participation:</td>
<td>8%</td>
</tr>
<tr>
<td>Total Asian American MBE Participation:</td>
<td>3%</td>
</tr>
<tr>
<td>Total Hispanic American MBE Participation:</td>
<td>3%</td>
</tr>
</tbody>
</table>

**Overall Goal**

Total MBE Participation (include all categories): 29%
PART 2 - MBE UTILIZATION AND FAIR SOLICITATION AFFIDAVIT

This MBE Utilization and Fair Solicitation Affidavit and MBE Participation Schedule must be completed and included with the bid/proposal. If the bidder/offeror fails to accurately complete and submit this Affidavit and the Schedule in Part 3 with the bid or proposal as required, the Procurement Officer shall deem the bid non-responsive or shall determine that the proposal is not reasonably susceptible of being selected for award.

In connection with the bid/proposal submitted in response to Solicitation No. TU-1949-SBR, I affirm the following:

1. **MBE Participation (PLEASE CHECK ONLY ONE)**

   - [ ] I acknowledge and intend to meet IN FULL both the overall certified Minority Business Enterprise (MBE) participation goal of **29** percent and all of the following subgoals:
     - **8** percent for African American-owned MBE firms
     - **3** percent for Hispanic American-owned MBE firms
     - **3** percent for Asian American-owned MBE firms

   Therefore, I am not seeking a waiver pursuant to COMAR 21.11.03.11. I acknowledge that by checking the above box and agreeing to meet the stated goal and subgoal(s), if any, I must complete Part 3 - MBE Participation Schedule and Part 4 Signature Page in order to be considered for award.

   **OR**

   - [ ] I conclude that I am unable to achieve the MBE participation goal and/or subgoals. I hereby request a waiver, in whole or in part, of the overall goal and/or subgoal(s). I acknowledge that by checking this box and requesting a partial waiver of the stated goal and/or one or more of the stated subgoal(s) if any, I must complete Part 3, the MBE Participation Schedule and Part 4 Signature Page for the portion of the goal and/or subgoal(s) if any, for which I am not seeking a waiver, in order to be considered for award. I acknowledge that by checking this box and requesting a full waiver of the stated goal and the stated subgoal(s) if any, I must complete Part 4 Signature Page in order to be considered for award.
Additional MBE Documentation

I understand that if I am notified that I am the apparent awardee or as requested by the Procurement Officer, I must submit the following documentation within 10 working days of receiving notice of the potential award or from the date of conditional award (per COMAR 21.11.03.10), whichever is earlier:

(a) Good Faith Efforts Documentation to Support Waiver Request (Attachment __-1C)
(b) Outreach Efforts Compliance Statement (Attachment __-2);
(c) MBE Subcontractor/MBE Prime Project Participation Statement (Attachments __-3A and 3B);
(d) Any other documentation, including additional waiver documentation if applicable, required by the Procurement Officer to ascertain bidder or offeror responsibility in connection with the certified MBE participation goal and subgoals, if any.

I understand that if I fail to return each completed document within the required time, the Procurement Officer may determine that I am not responsible and therefore not eligible for contract award. If the contract has already been awarded, the award is voidable.

Information Provided to MBE firms

In the solicitation of subcontract quotations or offers, MBE firms were provided not less than the same information and amount of time to respond as were non-MBE firms.
PART 3 - MBE PARTICIPATION SCHEDULE

Set forth below are the (i) certified MBEs I intend to use, (ii) the percentage of the total Contract value allocated to each MBE for this project and, (iii) the items of work each MBE will provide under the Contract. I have confirmed with the MDOT database that the MBE firms identified below (including any self-performing MBE prime firms) are performing work activities for which they are MDOT-certified.

<table>
<thead>
<tr>
<th>Prime Contractor</th>
<th>Project Description</th>
<th>Project/Contract Number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

LIST INFORMATION FOR EACH CERTIFIED MBE FIRM YOU AGREE TO USE TO ACHIEVE THE MBE PARTICIPATION GOAL AND SUBGOALS, IF ANY. MBE PRIMES: PLEASE COMPLETE BOTH SECTIONS A AND B BELOW.

SECTION A: For MBE Prime Contractors ONLY (including MBE Primes in a Joint Venture)

<table>
<thead>
<tr>
<th>MBE Prime Firm</th>
<th>Name: ____________________________________________</th>
</tr>
</thead>
<tbody>
<tr>
<td>MBE Certification Number: ___________</td>
<td></td>
</tr>
<tr>
<td>(If dually certified, check only one box.)</td>
<td></td>
</tr>
<tr>
<td>□ African American-Owned</td>
<td></td>
</tr>
<tr>
<td>□ Hispanic American-Owned</td>
<td></td>
</tr>
<tr>
<td>□ Asian American-Owned</td>
<td></td>
</tr>
<tr>
<td>□ Women-Owned</td>
<td></td>
</tr>
<tr>
<td>□ Other MBE Classification</td>
<td></td>
</tr>
<tr>
<td>NAICS code: ________________________________</td>
<td></td>
</tr>
</tbody>
</table>

Percentage of total Contract Value to be performed with own forces and counted towards the MBE overall participation goal (up to 50% of the overall goal): _______% Please refer to Item #8 in Part 1-Instructions of this document for new MBE participation guidelines regarding materials and supplies.

Percentage of total Contract Value to be performed with own forces and counted towards the subgoal, if any, for my MBE classification (up to 100% of not more than one subgoal): _______%

- □ Supplier, wholesaler and/or regular dealer (count 60%)
- □ Manufacturer (count 100%)
- □ Broker (count reasonable fee/commission only)
- □ Furnish and Install and other Services (count 100%)

Complete the applicable prompt (select only one) from prompts A-C below that applies to the type of work your firm is self-performing to calculate amount to be counted towards achieving the MBE Participation Goal and Subgoal, if any.

A. Percentage amount of subcontract where the MBE Prime firm is being used for manufacturer, furnish and install, and/or services (excluding products / services from suppliers, wholesalers, regular dealers and brokers) _______%

B. Percentage amount for items of work where the MBE Prime firm is being used as supplier, wholesaler, and/or regular dealer (60% Rule). Total percentage of Supplies/Products _______% x 60% = _______%

C. Percentage amount of fee where the MBE Prime firm is being used as broker (count reasonable fee/commission only) _______%

Description of the Work to be performed with MBE prime’s own forces: ____________________________________________
SECTION B: For all Contractors (including MBE Primes and MBE Primes in a Joint Venture)

<table>
<thead>
<tr>
<th>MBE Firm</th>
<th>Name: ____________________________________________________________</th>
</tr>
</thead>
<tbody>
<tr>
<td>MBE Certification Number: ____________________________</td>
<td></td>
</tr>
<tr>
<td>(If dually certified, check only one box.)</td>
<td></td>
</tr>
<tr>
<td>☐ African American-Owned</td>
<td></td>
</tr>
<tr>
<td>☐ Hispanic American-Owned</td>
<td></td>
</tr>
<tr>
<td>☐ Asian American-Owned</td>
<td></td>
</tr>
<tr>
<td>☐ Women-Owned</td>
<td></td>
</tr>
<tr>
<td>☐ Other MBE Classification</td>
<td></td>
</tr>
<tr>
<td>NAICS code: ____________________________</td>
<td></td>
</tr>
</tbody>
</table>

Please refer to Item #8 in Part 1- Instructions of this document for new MBE participation guidelines regarding materials and supplies.

- ☐ Supplier, wholesaler and/or regular dealer (count 60%)
- ☐ Manufacturer (count 100%)
- ☐ Broker (count reasonable fee/commission only)
- ☐ Furnish and Install and other Services (count 100%)

Complete the applicable prompt (select only one) from prompts A-C below that applies to the type of work that the MBE firm named to the left will be performing to calculate the amount to be counted towards achieving the MBE Participation Goal and Subgoal, if any.

A. Percentage amount of subcontract where the MBE firm is being used for manufacturer, furnish and install, and/or services (excluding products/services from suppliers, wholesalers, regular dealers and brokers) ______ %

B. Percentage amount for items of work where the MBE firm is being used as supplier, wholesaler, and/or regular dealer (60% Rule)).
   Total percentage of Supplies/Products ______ % x 60% = ______ %

C. Percentage amount of fee where the MBE firm is being used as broker (count reasonable fee/commission only) ______ %

Description of the Work to be Performed: ___________________________________________________________
Please refer to Item #8 in Part 1- Instructions of this document for new MBE participation guidelines regarding materials and supplies.

☐ Supplier, wholesaler and/or regular dealer (count 60%)
☐ Manufacturer (count 100%)
☐ Broker (count reasonable fee/commission only)
☐ Furnish and Install and other Services (count 100%)

Complete the applicable prompt (select only one) from prompts A-C below that applies to the type of work that for the MBE firm named to the left will be performing to calculate the amount to be counted towards achieving the MBE Participation Goal and Subgoal, if any.

A. Percentage amount of subcontract where the MBE firm is being used for manufacturer, furnish and install, and/or services (excluding products/services from suppliers, wholesalers, regular dealers and brokers) ______%  

B. Percentage amount for items of work where the MBE firm is being used as supplier, wholesaler, and/or regular dealer (60% Rule). Total percentage of Supplies/Products ______% × 60% = ______%  

C. Percentage amount of fee where the MBE firm is being used as broker (count reasonable fee/commission only) ______ %  

Description of the Work to be Performed:

_________________________________________________________
_____________________________________
____________________
PART 4 – SIGNATURE PAGE
To complete Affidavit committing to MBE(s) or requesting waiver, bidder/offeror must sign below

I solemnly affirm under the penalties of perjury that: (i) I have reviewed the instructions for the MBE Utilization & Fair Solicitation Affidavit and MBE Schedule, and (ii) the information contained in the MBE Utilization & Fair Solicitation Affidavit and MBE Schedule is true to the best of my knowledge, information and belief.

Bidder/Offeror Name  __________________________________________________________________________
(PLEASE PRINT OR TYPE)  __________________________ Signature of Authorized Representative

Address  __________________________________________________________________________________
_______________________________  __________________________________
_______________________________  __________________________________
City, State and Zip Code Printed Name and Title Date

SUBMIT THIS AFFIDAVIT WITH BID/PROPOSAL
MBE ATTACHMENT 1B
WAIVER GUIDANCE

GUIDANCE FOR DOCUMENTING GOOD FAITH EFFORTS TO MEET MBE PARTICIPATION GOALS

In order to show that it has made good faith efforts to meet the Minority Business Enterprise (MBE) participation goal (including any MBE subgoals) on a contract, the bidder/offeror must either (1) meet the MBE Goal(s) and document its commitments for participation of MBE Firms, or (2) when it does not meet the MBE Goal(s), document its Good Faith Efforts to meet the goal(s).

I. Definitions

MBE Goal(s) – “MBE Goal(s)” refers to the MBE participation goal and MBE participation subgoal(s).

Good Faith Efforts – The “Good Faith Efforts” requirement means that when requesting a waiver, the bidder/offeror must demonstrate that it took all necessary and reasonable steps to achieve the MBE Goal(s), which, by their scope, intensity, and appropriateness to the objective, could reasonably be expected to obtain sufficient MBE participation, even if those steps were not fully successful. Whether a bidder/offeror that requests a waiver made adequate good faith efforts will be determined by considering the quality, quantity, and intensity of the different kinds of efforts that the bidder/offeror has made. The efforts employed by the bidder/offeror should be those that one could reasonably expect a bidder/offeror to take if the bidder/offeror were actively and aggressively trying to obtain MBE participation sufficient to meet the MBE contract goal and subgoals. Mere pro forma efforts are not good faith efforts to meet the MBE contract requirements. The determination concerning the sufficiency of the bidder’s/offeror’s good faith efforts is a judgment call; meeting quantitative formulas is not required.

Identified Firms – “Identified Firms” means a list of the MBEs identified by the procuring agency during the goal setting process and listed in the procurement as available to perform the Identified Items of Work. It also may include additional MBEs identified by the bidder/offeror as available to perform the identified Items of Work, such as MBEs certified or granted an expansion of services after the procurement was issued. If the procurement does not include a list of Identified Firms, this term refers to all of the MBE Firms (if State-funded) the bidder/offeror identified as available to perform the Identified Items of Work and should include all appropriately certified firms that are reasonably identifiable.

Identified Items of Work – “Identified Items of Work” means the bid items identified by the procuring agency during the goal setting process and listed in the procurement as possible items of work for performance by MBE Firms. It also may include additional portions of items of work the bidder/offeror identified for performance by MBE Firms to increase the likelihood that the MBE Goal(s) will be achieved. If the procurement does not include a list of Identified Items of Work, this term refers to all of the items of work the bidder/offeror identified as possible items of work for performance by MBE Firms and should include all reasonably identifiable work opportunities.

MBE Firms – “MBE Firms” refers to a firm certified by the Maryland Department of Transportation (“MDOT”) under COMAR 21.11.03. Only MDOT-certified MBE Firms can participate in the State’s MBE Program.

II. Types of Actions Agency Will Consider

The bidder/offeror is responsible for making relevant portions of the work available to MBE subcontractors and suppliers and to select those portions of the work or material needs consistent with the available MBE subcontractors and suppliers, so as to facilitate MBE participation. The following is a list of types of actions the procuring agency will consider as part of the bidder’s/offeror’s Good Faith Efforts when the bidder/offeror fails to meet the MBE Goal(s). This list is not intended to be a mandatory checklist, nor is it intended to be exclusive or exhaustive. Other factors or types of efforts may be relevant in appropriate cases.
A. Identify Bid Items as Work for MBE Firms

1. Identified Items of Work in Procurements
   
   (a) Certain procurements will include a list of bid items identified during the goal setting process as possible work for performance by MBE Firms. If the procurement provides a list of Identified Items of Work, the bidder/offeror shall make all reasonable efforts to solicit quotes from MBE Firms to perform that work.
   
   (b) Bidders/Offerors may, and are encouraged to, select additional items of work to be performed by MBE Firms to increase the likelihood that the MBE Goal(s) will be achieved.

2. Identified Items of Work by Bidders/Offerors
   
   (a) When the procurement does not include a list of Identified Items of Work or for additional Identified Items of Work, bidders/offerors should reasonably identify sufficient items of work to be performed by MBE Firms.
   
   (b) Where appropriate, bidders/offerors should break out contract work items into economically feasible units to facilitate MBE participation, rather than perform these work items with their own forces. The ability or desire of a prime contractor to perform the work of a contract with its own organization does not relieve the bidder/offeror of the responsibility to make Good Faith Efforts.

B. Identify MBE Firms to Solicit

1. MBE Firms Identified in Procurements
   
   (a) Certain procurements will include a list of the MBE Firms identified during the goal setting process as available to perform the items of work. If the procurement provides a list of Identified MBE Firms, the bidder/offeror shall make all reasonable efforts to solicit those MBE firms.
   
   (b) Bidders/offerors may, and are encouraged to, search the MBE Directory to identify additional MBEs who may be available to perform the items of work, such as MBEs certified or granted an expansion of services after the solicitation was issued.

2. MBE Firms Identified by Bidders/Offerors
   
   (a) When the procurement does not include a list of Identified MBE Firms, bidders/offerors should reasonably identify the MBE Firms that are available to perform the Identified Items of Work.
   
   (b) Any MBE Firms identified as available by the bidder/offeror should be certified to perform the Identified Items of Work.

C. Solicit MBEs

1. Solicit all Identified Firms for all Identified Items of Work by providing written notice. The bidder/offeror should:
   
   (a) provide the written solicitation at least 10 days prior to bid opening to allow sufficient time for the MBE Firms to respond;
   
   (b) send the written solicitation by first-class mail, facsimile, or email using contact information in the MBE Directory, unless the bidder/offeror has a valid basis for using different contact information; and
   
   (c) provide adequate information about the plans, specifications, anticipated time schedule for portions of the work to be performed by the MBE, and other requirements of the contract to assist MBE Firms in responding. (This information may be provided by including hard copies in the written solicitation or by electronic means as described in C.3 below.)

2. “All” Identified Firms includes the MBEs listed in the procurement and any MBE Firms you identify as potentially available to perform the Identified Items of Work, but it does not include MBE Firms who are no longer certified to perform the work as of the date the bidder/offeror provides written solicitations.
3. “Electronic Means” includes, for example, information provided via a website or file transfer protocol (FTP) site containing the plans, specifications, and other requirements of the contract. If an interested MBE cannot access the information provided by electronic means, the bidder/offeror must make the information available in a manner that is accessible to the interested MBE.

4. Follow up on initial written solicitations by contacting MBEs to determine if they are interested. The follow up contact may be made:

   (a) by telephone using the contact information in the MBE Directory, unless the bidder/offeror has a valid basis for using different contact information; or

   (b) in writing via a method that differs from the method used for the initial written solicitation.

5. In addition to the written solicitation set forth in C.1 and the follow up required in C.4, use all other reasonable and available means to solicit the interest of MBE Firms certified to perform the work of the contract. Examples of other means include:

   (a) attending any pre-bid meetings at which MBE Firms could be informed of contracting and subcontracting opportunities; and

   (b) if recommended by the procurement, advertising with or effectively using the services of at least two minority focused entities or media, including trade associations, minority/women community organizations, minority/women contractors’ groups, and local, state, and federal minority/women business assistance offices listed on the MDOT Office of Minority Business Enterprise website.

D. Negotiate With Interested MBE Firms

Bidders/Offerors must negotiate in good faith with interested MBE Firms.

1. Evidence of negotiation includes, without limitation, the following:

   (a) the names, addresses, and telephone numbers of MBE Firms that were considered;

   (b) a description of the information provided regarding the plans and specifications for the work selected for subcontracting and the means used to provide that information; and

   (c) evidence as to why additional agreements could not be reached for MBE Firms to perform the work.

2. A bidder/offeror using good business judgment would consider a number of factors in negotiating with subcontractors, including MBE subcontractors, and would take a firm’s price and capabilities as well as contract goals into consideration.

3. The fact that there may be some additional costs involved in finding and using MBE Firms is not in itself sufficient reason for a bidder's/offeror's failure to meet the contract MBE goal(s), as long as such costs are reasonable. Factors to take into consideration when determining whether a MBE Firm’s quote is excessive or unreasonable include, without limitation, the following:

   (a) the dollar difference between the MBE subcontractor’s quote and the average of the other subcontractors’ quotes received by the bidder/offeror;

   (b) the percentage difference between the MBE subcontractor’s quote and the average of the other subcontractors’ quotes received by the bidder/offeror;

   (c) the percentage that the MBE subcontractor’s quote represents of the overall contract amount;

   (d) the number of MBE firms that the bidder/offeror solicited for that portion of the work;

   (e) whether the work described in the MBE and Non-MBE subcontractor quotes (or portions thereof) submitted for review is the same or comparable; and
(f) the number of quotes received by the bidder/offeror for that portion of the work.

4. The above factors are not intended to be mandatory, exclusive, or exhaustive, and other evidence of an excessive or unreasonable price may be relevant.

5. The bidder/offeror may not use its price for self-performing work as a basis for rejecting a MBE Firm’s quote as excessive or unreasonable.

6. The “average of the other subcontractors’ quotes received” by the bidder/offeror refers to the average of the quotes received from all subcontractors. Bidder/offeror should attempt to receive quotes from at least three subcontractors, including one quote from a MBE and one quote from a Non-MBE.

7. A bidder/offeror shall not reject a MBE Firm as unqualified without sound reasons based on a thorough investigation of the firm’s capabilities. For each certified MBE that is rejected as unqualified or that placed a subcontract quotation or offer that the bidder/offeror concludes is not acceptable, the bidder/offeror must provide a written detailed statement listing the reasons for this conclusion. The bidder/offeror also must document the steps taken to verify the capabilities of the MBE and Non-MBE Firms quoting similar work.

   (a) The factors to take into consideration when assessing the capabilities of a MBE Firm, include, but are not limited to the following: financial capability, physical capacity to perform, available personnel and equipment, existing workload, experience performing the type of work, conduct and performance in previous contracts, and ability to meet reasonable contract requirements.

   (b) The MBE Firm’s standing within its industry, membership in specific groups, organizations, or associations and political or social affiliations (for example union vs. non-union employee status) are not legitimate causes for the rejection or non-solicitation of bids in the efforts to meet the project goal.

E. Assisting Interested MBE Firms

When appropriate under the circumstances, the decision-maker will consider whether the bidder/offeror:

1. made reasonable efforts to assist interested MBE Firms in obtaining the bonding, lines of credit, or insurance required by the procuring agency or the bidder/offeror; and

2. made reasonable efforts to assist interested MBE Firms in obtaining necessary equipment, supplies, materials, or related assistance or services.

III. Other Considerations

In making a determination of Good Faith Efforts the decision-maker may consider engineering estimates, catalogue prices, general market availability and availability of certified MBE Firms in the area in which the work is to be performed, other bids or offers and subcontract bids or offers substantiating significant variances between certified MBE and Non-MBE costs of participation, and their impact on the overall cost of the contract to the University and any other relevant factors.

The decision-maker may take into account whether a bidder/offeror decided to self-perform subcontract work with its own forces, especially where the self-performed work is Identified Items of Work in the procurement. The decision-maker also may take into account the performance of other bidders/offerors in meeting the contract. For example, when the apparent successful bidder/offeror fails to meet the contract goal, but others meet it, this reasonably raises the question of whether, with additional reasonable efforts, the apparent successful bidder/offeror could have met the goal. If the apparent successful bidder/offeror fails to meet the goal, but meets or exceeds the average MBE participation obtained by other bidders/offerors, this, when viewed in conjunction with other factors, could be evidence of the apparent successful bidder/offeror having made Good Faith Efforts.

IV. Documenting Good Faith Efforts

At a minimum, a bidder/offeror seeking a waiver of the MBE Goal(s) or a portion thereof must provide written documentation of its Good Faith Efforts, in accordance with COMAR 21.11.03.11, within 10 business days after receiving notice that it is the apparent awardee. The written documentation shall include the following:
A. Items of Work (Complete Good Faith Efforts Documentation Attachment 1-C, Part 1)

A detailed statement of the efforts made to select portions of the work proposed to be performed by certified MBE Firms in order to increase the likelihood of achieving the stated MBE Goal(s).

B. Outreach/Solicitation/Negotiation

1. The record of the bidder’s/offor’s compliance with the outreach efforts prescribed by COMAR 21.11.03.09C(2)(a). (Complete Outreach Efforts Compliance Statement – Attachment 2).

2. A detailed statement of the efforts made to contact and negotiate with MBE Firms including:

   (a) the names, addresses, and telephone numbers of the MBE Firms who were contacted, with the dates and manner of contacts (letter, fax, email, telephone, etc.) (Complete Good Faith Efforts Attachment 1-C- Part 2, and submit letters, fax cover sheets, emails, etc. documenting solicitations); and

   (b) a description of the information provided to MBE Firms regarding the plans, specifications, and anticipated time schedule for portions of the work to be performed and the means used to provide that information.

C. Rejected MBE Firms (Complete Good Faith Efforts Attachment 1-C, Part 3)

1. For each MBE Firm that the bidder/offeror concludes is not acceptable or qualified, a detailed statement of the reasons for the bidder's/offor's conclusion, including the steps taken to verify the capabilities of the MBE and Non-MBE Firms quoting similar work.

2. For each certified MBE Firm that the bidder/offeror concludes has provided an excessive or unreasonable price, a detailed statement of the reasons for the bidder's/offor's conclusion, including the quotes received from all MBE and Non-MBE firms bidding on the same or comparable work. (Include copies of all quotes received.)

3. A list of MBE Firms contacted but found to be unavailable. This list should be accompanied by a MBE Unavailability Certificate (see Exhibit A to this Part 1) signed by the MBE contractor or a statement from the bidder/offeror that the MBE contractor refused to sign the MBE Unavailability Certificate.

D. Other Documentation

1. Submit any other documentation requested by the Procurement Officer to ascertain the bidder's/offor's Good Faith Efforts.

2. Submit any other documentation the bidder/offeror believes will help the Procurement Officer ascertain its Good Faith Efforts.
Exhibit A

MBE Subcontractor Unavailability Certificate

1. It is hereby certified that the firm of

(name of minority firm)

Located at

(Number) (Street)

(City) (State) (Zip)

Was offered an opportunity to bid on Solicitation No.

In County by

(Name of Prime Contractor’s Firm)

****************************************************************************************************************************

2. (Minority Firm) is either unavailable for the work/service or unable to

Bid for this project for the following reason(s)?

Signature of Minority Firm’s MBE Representative

Title

Date

MDOT Certification #

Telephone #

****************************************************************************************************************************

3. To be completed by the prime contractor if Section 2 of this form is not completed by the minority firm.

To the best of my knowledge and belief, said Certified Minority Business Enterprise is either unavailable for the work/service for this project, is unable to prepare a bid, or did not respond to a request for a price proposal and has not completed the above portion of this submittal.

Signature of Prime Contractor

Title

Date
# MBE ATTACHMENT 1C

**GOOD FAITH EFFORTS DOCUMENTATION TO SUPPORT WAIVER REQUEST**

**PAGE ____ OF ____**

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**PARTS 1, 2, AND 3 MUST BE INCLUDED WITH THIS CERTIFICATE ALONG WITH ALL DOCUMENTS SUPPORTING YOUR WAIVER REQUEST.**

I affirm that I have reviewed Attachment 1B, Waiver Guidance. I further affirm under penalties of perjury that the contents of Parts 1, 2, and 3 of this Attachment 1C Good Faith Efforts Documentation Form are true to the best of my knowledge, information, and belief.

_______________________________
Company Name

_______________________________
Signature of Representative

_______________________________
Address

_______________________________
Printed Name and Title

_______________________________
City, State and Zip Code

_______________________________
Date
GOOD FAITH EFFORTS DOCUMENTATION
TO SUPPORT WAIVER REQUEST

PART 1 – IDENTIFIED ITEMS OF WORK BIDDER/OFFEROR MADE AVAILABLE TO
MBE FIRMS

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Identify those items of work that the bidder/offeror made available to MBE Firms. This includes, where appropriate, those items the bidder/offeror identified and determined to subdivide into economically feasible units to facilitate the MBE participation. For each item listed, show the anticipated percentage of the total contract amount. It is the bidder’s/offeror’s responsibility to demonstrate that sufficient work to meet the goal was made available to MBE Firms, and the total percentage of the items of work identified for MBE participation equals or exceeds the percentage MBE goal set for the procurement. Note: If the procurement includes a list of bid items identified during the goal setting process as possible items of work for performance by MBE Firms, the bidder/offeror should make all of those items of work available to MBE Firms or explain why that item was not made available. If the bidder/offeror selects additional items of work to make available to MBE Firms, those additional items should also be included below.

<table>
<thead>
<tr>
<th>Identified Items of Work</th>
<th>Was this work listed in the procurement?</th>
<th>Does bidder/offeror normally self-perform this work?</th>
<th>Was this work made available to MBE Firms? If no, explain why?</th>
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☐ Please check if Additional Sheets are attached.
GOOD FAITH EFFORTS DOCUMENTATION
TO SUPPORT WAIVER REQUEST

PART 2 – IDENTIFIED MBE FIRMS AND RECORD OF SOLICITATIONS

Identify the MBE Firms solicited to provide quotes for the Identified Items of Work made available for MBE participation. Include the name of the MBE Firm solicited, items of work for which bids/quotes were solicited, date and manner of initial and follow-up solicitations, whether the MBE provided a quote, and whether the MBE is being used to meet the MBE participation goal. MBE Firms used to meet the participation goal must be included on the MBE Participation Schedule. Note: If the procurement includes a list of the MBE Firms identified during the goal setting process as potentially available to perform the items of work, the bidder/offeror should solicit all of those MBE Firms or explain why a specific MBE was not solicited. If the bidder/offeror identifies additional MBE Firms who may be available to perform Identified Items of Work, those additional MBE Firms should also be included below. Copies of all written solicitations and documentation of follow-up calls to MBE Firms must be attached to this form. This list should be accompanied by a Minority Contractor Unavailability Certificate signed by the MBE contractor or a statement from the bidder/offeror that the MBE contractor refused to sign the Minority Contractor Unavailability Certificate (see Exhibit A to MBE Attachment 1-B). If the bidder/offeror used a Non-MBE or is self-performing the identified items of work, Part 4 must be completed.

<table>
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<tr>
<th>Name of Identified MBE Firm &amp; MBE Classification</th>
<th>Describe Item of Work Solicited</th>
<th>Initial Solicitation Date &amp; Method</th>
<th>Follow-up Solicitation Date &amp; Method</th>
<th>Details for Follow-up Calls</th>
<th>Quote Rec’d</th>
<th>Quote Used</th>
<th>Reason Quote Rejected</th>
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<td>Firm Name:</td>
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<td>Date: ________</td>
<td>Time of Call: ____</td>
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<td>□ Used Other MBE</td>
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<td>MBE Classification</td>
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<td>Spoke With: ________</td>
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Please check if Additional Sheets are attached.
GOOD FAITH EFFORTS DOCUMENTATION
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PART 3 – ADDITIONAL INFORMATION REGARDING REJECTED MBE QUOTES

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This form must be completed if Part 1 indicates that a MBE quote was rejected because the bidder/offeror is using a Non-MBE or is self-performing the Identified Items of Work. Provide the Identified Items Work, indicate whether the work will be self-performed or performed by a Non-MBE, and if applicable, state the name of the Non-MBE. Also include the names of all MBE and Non-MBE Firms that provided a quote and the amount of each quote.

<table>
<thead>
<tr>
<th>Describe Identified Items of Work Not Being Performed by MBE (include spec/section number from bid)</th>
<th>Self-performing or Using Non-MBE (Provide name)</th>
<th>Amount of Non-MBE Quote</th>
<th>Name of Other Firms who Provided Quotes &amp; Whether MBE or Non-MBE</th>
<th>Amount Quoted</th>
<th>Indicate Reason Why MBE Quote Rejected &amp; Briefly Explain</th>
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□ Please check if Additional Sheets are attached.

TOWSON UNIVERSITY
Complete and submit this form within 10 working days of notification of apparent award or actual award, whichever is earlier.

In conjunction with the bid/proposal submitted in response to Solicitation No.__________, I state the following:

1. Bidder/Offeror identified subcontracting opportunities in these specific work categories:
   
   _______________________________________________________________
   _______________________________________________________________
   _______________________________________________________________

2. Attached to this form are copies of written solicitations (with bidding/proposal instructions) used to solicit certified MBE firms for these subcontract opportunities.

3. Bidder/Offeror made the following attempts to personally contact the solicited MDOT-certified MBE firms:
   
   _______________________________________________________________
   _______________________________________________________________
   _______________________________________________________________

4. Please Check One:

□ This project does not involve bonding requirements.
□ Bidder/Offeror assisted MDOT-certified MBE firms to fulfill or seek waiver of bonding requirements.

(DESCRIPTE EFFORTS): ________________________________

   _______________________________________________________________

5. Please Check One:

□ Bidder/Offeror did attend the pre-bid/pre-proposal conference.
□ No pre-bid/pre-proposal meeting/conference was held.
□ Bidder/Offeror did not attend the pre-bid/pre-proposal conference.

______________________________  ________________________________
Company Name                  Signature of Representative

______________________________  ________________________________
Address                       Printed Name and Title

______________________________  ________________________________
City, State and Zip Code       Date
MBE Attachment 3A

MBE SUBCONTRACTOR PROJECT PARTICIPATION CERTIFICATION

PLEASE COMPLETE AND SUBMIT ONE FORM FOR EACH CERTIFIED MBE FIRM LISTED ON THE MBE PARTICIPATION SCHEDULE (ATTACHMENT 1A) WITHIN 10 WORKING DAYS OF NOTIFICATION OF APPARENT AWARD. IF THE BIDDER/OFFEROR FAILS TO RETURN THIS AFFIDAVIT WITHIN THE REQUIRED TIME, THE PROCUREMENT OFFICER MAY DETERMINE THAT THE BIDDER/OFFEROR IS NOT RESPONSIBLE AND THEREFORE NOT ELIGIBLE FOR CONTRACT AWARD.

Provided that __________________________ (Prime Contractor’s Name) is awarded the contract in conjunction with Solicitation No. __________, such Prime Contractor intends to enter into a subcontract with ______________________ (Subcontractor’s Name) committing to participation by the MBE firm ______________________ (MBE Name) with MDOT Certification Number __________ which will receive at least $____________ which equals to ___% of the Total Contract Amount for performing the following products/services for the Contract:

<table>
<thead>
<tr>
<th>NAICS CODE</th>
<th>WORK ITEM, SPECIFICATION NUMBER, LINE ITEMS OR WORK CATEGORIES (IF APPLICABLE)</th>
<th>DESCRIPTION OF SPECIFIC PRODUCTS AND/OR SERVICES</th>
</tr>
</thead>
<tbody>
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</tbody>
</table>

Each of the Contractor and Subcontractor acknowledges that, for purposes of determining the accuracy of the information provided herein, the Procurement Officer may request additional information, including, without limitation, copies of the subcontract agreements and quotes. Each of the Contractor and Subcontractor solemnly affirms under the penalties of perjury that: (i) the information provided in this MBE Subcontractor Project Participation Affidavit is true to the best of its knowledge, information and belief, and (ii) has fully complied with the State Minority Business Enterprise law, State Finance and Procurement Article §14-308(a)(2), Annotated Code of Maryland which provides that, except as otherwise provided by law, a contractor may not identify a certified minority business enterprise in a Bid/Proposal and:

1. fail to request, receive, or otherwise obtain authorization from the certified minority business enterprise to identify the certified Minority Business Enterprise in its Bid/Proposal;
2. fail to notify the certified Minority Business Enterprise before execution of the Contract of its inclusion of the Bid/Proposal;
3. fail to use the certified Minority Business Enterprise in the performance of the Contract; or
4. pay the certified Minority Business Enterprise solely for the use of its name in the Bid/Proposal.

<table>
<thead>
<tr>
<th>PRIME CONTRACTOR</th>
<th>SUBCONTRACTOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signature of Representative:</td>
<td>Signature of Representative:</td>
</tr>
<tr>
<td>Printed Name and Title:</td>
<td>Printed Name and Title:</td>
</tr>
<tr>
<td>Firm’s Name:</td>
<td>Firm’s Name:</td>
</tr>
<tr>
<td>Federal Identification Number:</td>
<td>Federal Identification Number:</td>
</tr>
<tr>
<td>Address:</td>
<td>Address:</td>
</tr>
<tr>
<td>Telephone: _______________ Date: _______________</td>
<td>Telephone: _______________ Date: _______________</td>
</tr>
</tbody>
</table>
MBE Attachment 3B

MBE PRIME PROJECT PARTICIPATION CERTIFICATION

PLEASE COMPLETE AND SUBMIT THIS FORM TO ATTEST EACH SPECIFIC ITEM OF WORK THAT YOUR MBE FIRM HAS LISTED ON THE MBE PARTICIPATION SCHEDULE (ATTACHMENT __-1A) FOR PURPOSES OF MEETING THE MBE PARTICIPATION GOALS. THIS FORM MUST BE SUBMITTED WITHIN 10 WORKING DAYS OF NOTIFICATION OF APPARENT AWARD. IF THE BIDDER/OFFEROR FAILS TO RETURN THIS AFFIDAVIT WITHIN THE REQUIRED TIME, THE PROCUREMENT OFFICER MAY DETERMINE THAT THE BIDDER/OFFEROR IS NOT RESPONSIBLE AND THEREFORE NOT ELIGIBLE FOR CONTRACT AWARD.

Provided that _______________________________ (Prime Contractor’s Name) with Certification Number ____________ is awarded the contract in conjunction with Solicitation No. ______________________, such MBE Prime Contractor intends to perform with its own forces at least $___________ which equals to ___% of the Total Contract Amount for performing the following products/services for the Contract:

<table>
<thead>
<tr>
<th>NAICS CODE</th>
<th>WORK ITEM, SPECIFICATION NUMBER, LINE ITEMS OR WORK CATEGORIES (IF APPLICABLE), FOR CONSTRUCTION PROJECTS, GENERAL CONDITIONS MUST BE LISTED SEPARATELY.</th>
<th>DESCRIPTION OF SPECIFIC PRODUCTS AND/OR SERVICES</th>
<th>VALUE OF THE WORK</th>
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</table>

MBE PRIME CONTRACTOR

________________________________________
Signature of Representative:

________________________________________
Printed Name and Title

________________________________________
Firm’s Name:

Federal Identification Number: ________________________________

Address: _______________________________________________________

________________________________________
Telephone: ___________________________ Date: ___________________
Report #: ______________________
Reporting Period (Month/Year): ______
Prime Contractor: Report is due to the MBE Liaison, by the 10th of the month following the month the services were provided.
Note: Please number reports in sequence

<table>
<thead>
<tr>
<th>Report #:</th>
<th>Contract #:</th>
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<tr>
<th>Reporting Period (Month/Year):</th>
<th>Contracting Unit:</th>
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<table>
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<tr>
<th>Prime Contractor:</th>
<th>Contact Person:</th>
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<th>City:</th>
<th>State:</th>
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<th>Phone:</th>
<th>Fax:</th>
<th>E-mail:</th>
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<tr>
<th>MBE Subcontractor Name:</th>
<th>Contact Person:</th>
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<th>Prime Contractor:</th>
<th>Contact Person:</th>
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<th>City:</th>
<th>State:</th>
<th>ZIP:</th>
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<th>Phone:</th>
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<th>MBE Subcontractor Name:</th>
<th>Contact Person:</th>
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<th>Phone:</th>
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<th>MBE Subcontractor Name:</th>
<th>Contact Person:</th>
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<th>Phone:</th>
<th>Fax:</th>
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</table>

Subcontractor Services Provided:

List all payments made to MBE subcontractor named above during this reporting period:

<table>
<thead>
<tr>
<th>Invoice#</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>$</td>
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<tr>
<td>2.</td>
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<tr>
<td>3.</td>
<td>$</td>
</tr>
<tr>
<td>4.</td>
<td>$</td>
</tr>
</tbody>
</table>

Total Dollars Paid: $

List dates and amounts of any outstanding invoices:

<table>
<thead>
<tr>
<th>Invoice#</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>$</td>
</tr>
<tr>
<td>2.</td>
<td>$</td>
</tr>
<tr>
<td>3.</td>
<td>$</td>
</tr>
<tr>
<td>4.</td>
<td>$</td>
</tr>
</tbody>
</table>

Total Dollars Paid: $

- If more than one MBE subcontractor is used for this contract, you must use separate 4A forms for each subcontractor.
- Information regarding payments that the MBE prime will use for purposes of meeting the MBE participation goals must be reported separately in Attachment 4B.
- Return one copy (hard or electronic) of this form to the following address (electronic copy with signature and date is preferred):

  Victoria Nellis
  Towson University
  Procurement Department
  8000 York Road
  Towson, MD 21252
  MBE@towson.edu
  Ph: 410-704-2697
  Fax: 410-704-8233

Prime Contractor Signature: ________________________________  Date: __________
(Required)
### MBE Prime Contractor Report

**MBE Prime Contractor:** ____________________________

**Certification Number:** ____________________________

**Report #:** ____________________________

**Reporting Period (Month/Year):** ____________________________

**MBE Prime Contractor:** Report is due to the MBE Liaison, by the 10th of the month following the month the services were provided.

**Note:** Please number reports in sequence

---

**Contact Person:**

**Address:**

**City:** ____________________________ | **State:** ____________________________ | **ZIP:** ____________________________

**Phone:** ____________________________ | **Fax:** ____________________________ | **E-mail:** ____________________________

---

<table>
<thead>
<tr>
<th>Invoice Number</th>
<th>Value of the Work</th>
<th>NAICS Code</th>
<th>Description of the Work</th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
</tbody>
</table>

**Contract #:** ____________________________

**Contracting Unit:** ____________________________

**Contract Amount:** ____________________________

**Total Value of the Work to the Self-Performed for purposes of Meeting the MBE participation goal/subgoals:** ____________________________

**Project Begin Date:** ____________________________

**Project End Date:** ____________________________

---

Return one copy (hard or electronic) of this form to the following address (electronic copy with signature and date is preferred):

Victoria Nellis  
Towson University  
Procurement Department  
8000 York Road  
Towson, MD 21252  
MBE@towson.edu  
Phone: 410-704-2697  
Fax: 410-704-8233

**Signature:** ____________________________  
**Date:** ____________________________  
(Required)
This form must be completed monthly by all MBE subcontractors

**MBE Attachment 5**

**Minority Business Enterprise Participation**

**Subcontractor Paid/Unpaid MBE Invoice Report**

<table>
<thead>
<tr>
<th>Report #: __________________</th>
<th>Contract #: __________________</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reporting Period (Month/Year): ____________</td>
<td>Contracting Unit: __________________</td>
</tr>
<tr>
<td></td>
<td>Contract Amount: __________________</td>
</tr>
<tr>
<td></td>
<td>MBE Subcontract Amt: __________________</td>
</tr>
<tr>
<td></td>
<td>Project Begin Date: __________________</td>
</tr>
<tr>
<td></td>
<td>Project End Date: __________________</td>
</tr>
<tr>
<td></td>
<td>Services Provided: __________________</td>
</tr>
</tbody>
</table>

**MBE Subcontractor Name:**

<table>
<thead>
<tr>
<th>MDOT Certification #:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contact Person:</td>
</tr>
<tr>
<td>Address:</td>
</tr>
<tr>
<td>City:</td>
</tr>
<tr>
<td>Phone:</td>
</tr>
</tbody>
</table>

**Subcontractor Services Provided:**

**List all payments received from Prime Contractor during reporting period indicated above:**

<table>
<thead>
<tr>
<th>Invoice Amt.</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. $ ____________</td>
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<tr>
<td>2. $ ____________</td>
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</tr>
<tr>
<td>3. $ ____________</td>
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<tr>
<td>4. $ ____________</td>
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</tr>
</tbody>
</table>

**Total Dollars Paid:** $

**List dates and amounts of any unpaid invoices over 30 days old:**

<table>
<thead>
<tr>
<th>Invoice Amt.</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. $ ____________</td>
<td></td>
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<tr>
<td>2. $ ____________</td>
<td></td>
</tr>
<tr>
<td>3. $ ____________</td>
<td></td>
</tr>
<tr>
<td>4. $ ____________</td>
<td></td>
</tr>
</tbody>
</table>

**Total Dollars Paid:** $

**Prime Contractor:**

<table>
<thead>
<tr>
<th>Contact Person:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Signature: __________________</th>
<th>Date: __________________</th>
</tr>
</thead>
</table>

Victoria Nellis  
Towson University Procurement Dept.  
MBE@towson.edu  
Phone: 410-704-2697  
Fax: 410-704-8233
COMPANY NAME: ________________________________

DATE OF INCORPORATION: ____________ STATE OF INCORPORATION: ____________

TYPE OF WORK PERFORMED: ________________________________

______________________________________________________

______________________________________________________

NUMBER OF YEARS IN BUSINESS: ______________

OTHER OR FORMER NAMES UNDER WHICH YOUR ORGANIZATION HAS OPERATED:

______________________________________________________

TYPE OR ORGANIZATION: (I.E., CORP., PARTNERSHIP, INDIVIDUAL, JOINT VENTURE, OTHER):

______________________________________________________

NAME OF PRINCIPAL(S) AND TITLE(S): ________________________________

______________________________________________________

______________________________________________________

BRIEF HISTORY OF COMPANY: ________________________________

______________________________________________________

______________________________________________________

TOTAL NUMBER OF EMPLOYEES: ______________

NUMBER OF FIELD EMPLOYEES (Excluding Supervisory): ______________

NUMBER OF FIELD SUPERVISORY PERSONNEL: ______________

NUMBER OF OFFICE PERSONNEL (Excluding Supervisory): ______________

NUMBER OF OFFICE SUPERVISORY PERSONNEL: ______________

BONDING CO.: ______________ BONDING CAPACITY: ______________
EXHIBIT G
FIRM EXPERIENCE

Duplicate as necessary to provide all required experience.

PROPOSER: ______________________________

PROJECT NAME: __________________________

PROJECT DOLLAR SIZE: ____________________

START DATE: ______________________________

COMPLETION DATE: _________________________

CLIENT/CUSTOMER: _________________________

ADDRESS: _________________________________

CONTACT PERSON: __________________________

TELEPHONE NUMBER: _______________________

FAX NUMBER: _______________________________

EMAIL: ________________________________

PROJECT MANAGER: _______________________

BRIEF, BUT DETAILED DESCRIPTION OF THE PROJECT:

_________________________________________________________________________

_________________________________________________________________________

_________________________________________________________________________

_________________________________________________________________________

_________________________________________________________________________

SIMILARITIES BETWEEN THIS PROJECT AND TU PROJECT:

_________________________________________________________________________

_________________________________________________________________________

_________________________________________________________________________

_________________________________________________________________________

_________________________________________________________________________

_________________________________________________________________________
EXHIBIT H
BID BOND

KNOW ALL MEN BY THESE PRESENTS, that we, ________________________________ (Bidding Company)
as Principal, hereinafter called the Principal, and ________________________________ (Bonding Company)
a corporation duly organized under the laws of the State of ________________________________, as Surety,
hereinafter called the Surety, are held and firmly bound unto the State of Maryland, hereinafter called “State,”
for the sum of ________________________________ Dollars (or $ ________________________________), for the payment of which
sum, the said Principal and the said Surety bind ourselves, our heirs, executors, administrators, successors
and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has submitted a bid for ________________________________

(Identify project by number and brief description)

NOW, THEREFORE, if the Principal, upon acceptance by the State of its bid identified above, within the period
specified therein for acceptance (ninety (90) days, if no period is specified), shall execute such further
contractual documents, if any, and give such bond(s) as may be required by the terms of the bid as accepted
within the time specified (ten (10) days if no period is specified) after receipt of the forms, or in the event of
failure so to execute such further contractual documents and give such bonds, if the Principal shall pay the
State the difference not to exceed the penalty hereof between the amount specified in the Principal’s bid and
such larger amount for which the State may in good faith contract with another party to perform the work
covered by said bid, then the above obligation shall be void and of no effect.

The Surety executing this instrument hereby agrees that its obligation shall not be impaired by any
extension(s) of the time for acceptance of the bid that the Principal may grant to the State, notice of which
extension(s) to the Surety being hereby waived; provided that such waiver of notice shall apply only with
respect to extensions aggregating not more than ninety (90) calendar days in addition to the period originally
allowed for acceptance of the bid.

In Presence of:
Witness

______________________________ as to ________________________________
______________________________

Individual Principal

______________________________ (Name)
______________________________ (SEAL)

In Presence of: Partnership Principal
Witness

______________________________ as to ________________________________
______________________________ as to ________________________________
______________________________ as to ________________________________

By: ________________________________ (SEAL)
By: ________________________________ (SEAL)
By: ________________________________ (SEAL)

Partner
Partner
Partner

Attest:
Corporate Principal

______________________________ (Name of Corporation)
Attest:

CORPORATE Secretary

Bonding Agent’s Name ______________________
Agent’s Address _______________________

Approved as to form and legal sufficiency
this _____ day of ______________________, 20____

Associate University Counsel

AFFIX

__________________________________________  By: ________________________________
President SEAL

______________________________________________
(Surety) AFFIX

__________________________________________  By: ________________________________
Attorney-in-fact SEAL

__________________________________________
Corporate Seal
EXHIBIT I
PERFORMANCE BOND

Principal

Surety

a corporation of the State of______________________________
and authorized to do business in the State of Maryland

Obligee

STATE OF MARYLAND
By and through the following Administration
TOWSON UNIVERSITY

Penal Sum of Bond (express in words and figures)

Description of Contract

Date of Contract _____________________________, 20__

Date Bond Executed _____________________________, 20__

Contract Number

KNOW ALL MEN BY THESE PRESENTS, That we, the Principal named above and Surety named above, being authorized to do business in Maryland, and having business addresses as shown above, are held and firmly bound unto the Obligee named above in the Penal Sum of this Performance Bond stated above, for the payment of which Penal Sum we bind ourselves, our heirs, executors, administrators, personal representatives, successors, and assigns, jointly and severally, firmly by these presents. However, where Surety is composed of corporations acting as co-sureties, we, the co-sureties, bind ourselves, our successors and assigns, in such Penal Sum jointly and severally as well as severally only for the purpose of allowing a joint action or actions against any or all of us, and for all other purposes each co-surety binds itself, jointly and severally with the Principal, for the payment of such sum as appears above its name below, but if no limit of liability is indicated, the limit of such liability shall be the full amount of Penal Sum.

WHEREAS, Principal has entered into or will enter into a contract with the State of Maryland, by and through the Administration named above acting for the State of Maryland, which contract is described and dated as shown above, and incorporated herein by reference. The contract and all items incorporated into the contract, together with any and all changes, extensions of time, alterations, modifications, or additions to the contract or to the work to be performed thereunder or to the Plans, Specifications, and Special Provisions, or any of them, or to any other items incorporated into the contract shall hereinafter be referred to as “the Contract.”

WHEREAS, it is one of the conditions precedent to the final award of the Contract that these presents be executed.

NOW, THEREFORE, during the original term of said Contract, during any extensions thereto that may be granted by the Administration, and during the guarantee and warranty period, if any, required under the Contract, unless otherwise stated therein, this Performance Bond shall remain in full force and effect unless and until the following terms and conditions are met:

1. Principal shall well and truly perform the Contract; and
2. Principal and Surety shall comply with the terms and conditions contained in this Performance Bond.

Whenever Principal shall be declared by the Administration to be in default under the Contract, the Surety may, within 15 days after notice of default from the Administration, notify the Administration of its election to either promptly proceed to remedy the default or promptly proceed to complete the contract in accordance with and subject to its terms and conditions. In the event the Surety does not elect to exercise either of the above stated options, then the Administration thereupon shall have the remaining contract work completed, Surety to remain liable hereunder for all expenses of completion up to but not exceeding the penal sum stated above.

The Surety hereby stipulates and agrees that no change, extension of time, alteration or addition to the terms of the Contract or to the work to be performed thereunder or the Specifications accompanying the same shall in any way affect its obligations on this Performance Bond, and it does hereby waive notice of any such change, extension of time, alteration or addition to the terms of the Contract or to the work or to the Specifications.

This Performance Bond shall be governed by and construed in accordance with the laws of the State of Maryland and any reference herein to Principal or Surety in the singular shall include all entities in the plural who or which are signatories under the Principal or Surety heading below.

IN WITNESS WHEREOF, Principal and Surety have set their hands and seals to this Performance Bond. If any individual is a signatory under the Principal heading below, then each such individual has signed below on his or her own behalf, has set forth below the name of...
the firm, if any, in whose name he or she is doing business, and has set forth below his or her title as a sole proprietor. If any partnership or joint venture is a signatory under the Principal heading below, then all members of each such partnership or joint venture have signed below, each member has set forth below the name of the partnership or joint venture, and each member has set forth below his or her title as a general partner, limited partner, or member of joint venture, whichever is applicable. If any corporation is a signatory under the Principal or Surety heading below, then each such corporation has caused the following: the corporation’s name to be set forth below, a duly authorized representative of the corporation to affix below the corporation’s seal and to attach hereto a notarized corporate resolution or power of attorney authorizing such action, and each such duly authorized representative to sign below and to set forth below his or her title as a representative of the corporation. If any individual acts as a witness to any signature below, then each such individual has signed below and has set forth below his or her title as a witness. All of the above has been done as of the Date of Bond shown above.

In Presence of:
Witness

____________________ as to __________________________ (SEAL)

Individual Principal

____________________ as to __________________________ (SEAL)

In Presence of:
Witness

Co-Partnership Principal

____________________ (SEAL)

Name of Co-Partnership

____________________ as to By: __________________________ (SEAL)

____________________ as to __________________________ (SEAL)

____________________ as to __________________________ (SEAL)

Corporate Principal

____________________

Name of Corporation

____________________ By: __________________________ CORPORATE SEAL

Corporate Secretary President with Title

Affix Corporate Seal

____________________

Surety

____________________ By: __________________________ CORPORATE SEAL

(SEAL)

Attest:

____________________ Title: __________________________

Signature

Bonding Agent’s Name: ______________________________

Business Address of Surety

Agent’s Address: ________________________________

Approved as to legal form and sufficiency this _____ day of ________, 20_____

______________________________________________

Director of Procurement
EXHIBIT J
PAYMENT BOND

Principal

Business Address of Principal

Surety

Obligee

a corporation of the State of ________________

and authorized to do business in the State of Maryland

STATE OF MARYLAND

By and through the following Administration

TOWSON UNIVERSITY

Penal Sum of Bond (express in words and figures)

Description of Contract

Date of Contract, 20_

Date Bond Executed, 20_

Contract Number

KNOW ALL MEN BY THESE PRESENTS, That we, the Principal named above and Surety named above, being authorized to do business in Maryland, and having business addresses as shown above, are held and firmly bound unto the Obligee named above, for the use and benefit of claimants as hereinafter defined, in the Penal Sum of this Payment Bond stated above, for the payment of which Penal Sum we bind ourselves, our heirs, executors, administrators, personal representatives, successors, and assigns, jointly and severally, firmly by these presents. However, where Surety is composed of corporations acting as co-sureties, we, the co-sureties, bind ourselves, our successors and assigns, in such Penal Sum jointly and severally as well as severally only for the purpose of allowing a joint action or actions against any or all of us, and for all other purposes each co-surety binds itself, jointly and severally with the Principal, for the payment of such sum as appears above its name below, but if no limit of liability is indicated, the limit of such liability shall be the full amount of the Penal Sum.

WHEREAS, Principal has entered into or will enter into a contract with the State, by and through the Administration named above acting for the State of Maryland, which contract is described and dated as shown above, and incorporated herein by reference. The contract and all items incorporated into the contract, together with any and all changes, extensions of time, alterations, modifications, or additions to the contract or to the work to be performed thereunder or to the Plans, Specifications, and Special Provisions, or any of them, or to any other items incorporated into the contract shall hereinafter be referred to as “the Contract.”

WHEREAS, it is one of the conditions precedent to the final award of the Contract that these presents be executed.

NOW, THEREFORE, the condition of this obligation is such that if the Principal shall promptly make payment to all claimants as hereinafter defined, for all labor and materials furnished, supplied and reasonably required for use in the performance of the Contract, then this obligation shall be null and void; otherwise it shall remain in full force and effect, subject to the following conditions:

1. A claimant is defined to be any and all of those persons supplying labor and materials (including lessors of the equipment to the extent of the fair market value be thereof) to the Principal or its subcontractors and subcontractors in the prosecution of the work provided for in the Contract, entitled to the protection provided by Section 9-113 of the Real Property Article of the Annotated Code of Maryland, as from time to time amended.

2. The above named Principal and Surety hereby jointly and severally agree with the Obligee that every claimant as herein defined, who has not been paid in full may, pursuant to and when in compliance with the provisions of the aforesaid Section 9-113, sue on this Bond for the use of such claimant, prosecute the suit to final judgment for such sum or sums as may be justly due claimant and have execution thereon. The Obligee shall not be liable for the payment of any costs or expenses of any such suit.
The Surety hereby stipulates and agrees that no change, extension of time, alteration or addition to the terms of the Contract or to the work to be performed thereunder or the Specifications accompanying the same shall in any way affect its obligations on this Payment Bond, and it does hereby waive notice of any such change, extension of time, alteration or addition to the terms of the Contract or to the work or to the Specifications.

This Payment Bond shall be governed by and construed in accordance with the laws of the State of Maryland and any reference herein to the Principal or Surety in the singular shall include all entities in the plural who or which are signatories under the Principal or Surety heading below.

IN WITNESS WHEREOF, Principal and Surety have set their hands and seals to this Payment Bond. If any individual is a signatory under the Principal heading below, then each such individual has signed below on his or her own behalf, has set forth below the name of the firm, if any, in whose name he or she is doing business, and has set forth below his or her title as a sole proprietor. If any partnership or joint venture is a signatory under the Principal heading below, then all members of each such partnership or joint venture have signed below, each member has set forth below the name of the partnership or joint venture, and each member has set forth below his or her title as a general partner, limited partner, or member of joint venture, whichever is applicable. If any corporation is a signatory under the Principal or Surety heading below, then each such corporation has caused the following: the corporation's name to be set forth below, a duly authorized representative of the corporation to affix below the corporation's seal and to attach hereto a notarized corporate resolution or power of attorney authorizing such action, and each such duly authorized representative to sign below and to set forth below his or her title as a representative of the corporation. If any individual acts as a witness to any signature below, then each such individual has signed below and has set forth below his or her title as a witness. All of the above has been done as of the Date of Bond shown above.

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<td>Name of Co-Partnership</td>
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<tr>
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<tr>
<td>Name of Corporation</td>
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<tr>
<td>By: ____________________ (SEAL)</td>
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<tr>
<td>President with Title</td>
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<td>AFFIX CORPORATE SEAL</td>
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<td>AFFIX CORPORATE SEAL</td>
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<tr>
<td>Signature</td>
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<tr>
<td>Title: ____________________</td>
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<tr>
<td>Bonding Agent's Name: ____________________</td>
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<tr>
<td>Business Address of Surety</td>
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<td>Agent's Address: ____________________</td>
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</table>

Approved as to legal form and sufficiency this _____ day of __________, 20____

Director of Procurement
EXHIBIT K
ADDENDA ACKNOWLEDGMENT

NAME OF BIDDER: ________________________________________

SOLICITATION NUMBER: ________________________________________

PROJECT TITLE: ________________________________________

DUE DATE: ________________________________________

ACKNOWLEDGMENT

I hereby acknowledge receipt of the following addenda which have been issued regarding the above referenced solicitation:

Addendum #1, issue date ____________________________
Addendum #2, issue date ____________________________
Addendum #3, issue date ____________________________
Addendum #4, issue date ____________________________
Addendum #5, issue date ____________________________
Addendum #6, issue date ____________________________
Addendum #7, issue date ____________________________
Addendum #8, issue date ____________________________
Addendum #9, issue date ____________________________
Addendum #10, issue date ____________________________

________________________________________
Signature

____________________________
Printed Name

____________________________
Title

____________________________
Company

____________________________
Date
EXHIBIT L
KEY PERSONNEL FORM

SOLICITATION/CONTRACT TITLE: __________________________________________________________

SOLICITATION/CONTRACT NUMBER: ____________________________________________________

1. BIDDER/OFFEROR NAME: ____________________________________________________________

2. KEY PERSONNEL NAME: ____________________________________________________________

3. POSITION TO BE ASSIGNED: Check applicable
   _____ Project Manager
   _____ Field Superintendent
   _____ Other. Title __________________________

4. EDUCATIONAL BACKGROUND:

   Institution                  Degree/Diploma/ Certification          Major (if any)              Date of Degree
   ___________________________ ___________________________ ___________________________
   ___________________________ ___________________________ ___________________________
   ___________________________ ___________________________ ___________________________

5. EMPLOYMENT HISTORY. If key personnel have more than three (3) previous employers, provide
complete employment history via supplemental page(s) attached to this form.

   5.1 CURRENT EMPLOYER: ____________________________________________________________

      DATES OF EMPLOYMENT: __________________________________________________________

      POSITION(S) HELD                  DURATION BY DATE
      ________________________________ ________________________________
      ________________________________ ________________________________

   5.2 PRIOR EMPLOYER: ______________________________________________________________

      DATES OF EMPLOYMENT: __________________________________________________________

      POSITION(S) HELD                  DURATION BY DATE
      ________________________________ ________________________________
      ________________________________ ________________________________

NOTE: If space provided is insufficient, attach additional page(s) and indicate “See attached.”
CONTRACT NAME ____________________________________________________________

CONTRACT NUMBER ________________________________________________________

EXHIBIT L - KEY PERSONNEL FORM

5.3 PRIOR EMPLOYER: ________________________________

DATES OF EMPLOYMENT: ________________________________

POSITION(S) HELD                  DURATION BY DATE

_________________________________________  _____________________________

_________________________________________  _____________________________

6.   PROJECT REFERENCES. Furnish reference data for project owners/clients for specific projects to which key personnel were assigned. References from projects listed on Attachment A are preferred.

6.1 CONTACT PERSON: ____________________________  TELEPHONE #: _____________

COMPANY NAME: __________________________________________

EMAIL ADDRESS: __________________________________________

DESCRIPTION OF CONTRACT/PROJECT: __________________________

6.2 CONTACT PERSON: ____________________________  TELEPHONE #: _____________

COMPANY NAME: __________________________________________

EMAIL ADDRESS: __________________________________________

DESCRIPTION OF CONTRACT/PROJECT: __________________________

6.3 CONTACT PERSON: ____________________________  TELEPHONE #: _____________

COMPANY NAME: __________________________________________

EMAIL ADDRESS: __________________________________________

DESCRIPTION OF CONTRACT/PROJECT DONE: ______________________

7.   ACHIEVEMENTS/OTHER NOTATIONS (Optional):

_________________________________________________________________________

_________________________________________________________________________

8.   SIMILAR PROJECT/CONTRACT EXPERIENCE. Complete a separate *Attachment A to Key Personnel Form for all key personnel proposed. At a minimum, include Project Manager and, if applicable, Field Superintendent(s). List at least three (3) prior projects for each.

NOTE: If space provided is insufficient, attach additional page(s) and indicate “See attached.”
8. SIMILAR PROJECT/CONTRACT EXPERIENCE

<table>
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<th>PROJECT NAME/LOCATION</th>
<th>PROJECT DESCRIPTION</th>
<th>KEY PERSONNEL ROLE</th>
<th>PROJECT VALUE</th>
<th>START AND COMPLETION DATES</th>
<th>OWNER/CLIENT CONTACT/TELEPHONE #</th>
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Note: List a minimum of three (3) projects for all key personnel proposed.
General Conditions for
Construction and Maintenance Contracts

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SECTION 1 - DEFINITIONS AND RESPONSIBILITIES

1.01 DEFINITIONS

A. “Contract.” The written agreement executed between the University and Contractor, covering performance of the work and furnishing of labor, services, equipment, and materials, and by which Contractor is bound to perform the work and furnish the labor, services, equipment and materials, and by which the University is obligated to compensate Contractor at the established and accepted rate or price. The contract documents shall include the proposal, contract forms and bonds, general conditions, specifications, addenda, supplemental specifications, all special provisions, all technical provisions, all plans, and notice to proceed; also any written change orders and supplemental agreements that are required to complete the work in an acceptable manner, including authorized extensions thereof.

B. “Contractor.” The person or organization having a direct contractual relationship with the University for execution of the Work. If Contractor hereunder is comprised of more than one legal entity, each such entity shall be jointly and severally liable under the Contract.

C. “Contract Time and Completion Date.” The number of working or calendar days shown in the proposal indicating the time allowed for the completion of the work contemplated in the contract. In case a calendar date of completion is shown in the proposal, in lieu of the number of working or calendar days, such work shall be completed on or before that calendar date.

D. “Day.” Means calendar day unless otherwise designated.

E. “Towson University” or “the University.” Refers to Towson University, an agency and instrumentality of the State of Maryland. In particular, the University refers to the campus or administrative unit of the University or its authorized representative that issues information relative to a particular transaction.

F. “Notice to Proceed.” A written notice to Contractor of the date on or before which it shall begin the prosecution of the work to be done under the Contract.

G. “Procurement Officer.” The person identified at the work initiation conference and designated by the University to make decisions with respect to administration of the work.

H. “Repair.” Where used in the Contract documents repair shall mean to restore after injury, deterioration, or wear; to mend, to renovate by such means as appropriate, and to supply such materials and labor as necessary to render the item to be repaired sound, solid, true, plumb, square, even, smooth and fully serviceable. Upon completion, such repair must be, unless otherwise stated, rendered to such condition as to present a first-class finished work, or in instances where the repaired item serves as a base for additional finish, the repaired work must be such as to permit a first-class finish, to be applied without extra cost to the University. When the word “repair” is used in connection with machinery or mechanical equipment it shall mean, in addition to the above, rendering the equipment completely serviceable and efficient, ready for normal use for which it was intended originally.
I. “Owner” or "State” or "University.” The State of Maryland acts only through its Board of Public Works. No action or representation is binding upon the State or Towson University unless it is made by, ratified by, or delegated by the Board of Public Works. Actions or representations made by the University staff do not bind the State or the University unless so provided in law.

J. “Subcontractor.” As employed herein includes only those having a direct contract with the Contractor. It includes one who furnishes material worked to a special design according to the plans and specifications for the Work, but excludes one who merely furnishes material not so worked.

K. "Supplemental Agreement.” A written agreement covering added or changed work which is beyond the scope of the contract and the changes clause. A supplemental agreement becomes a part of the contract when approved and properly executed by all parties to the contract.

L. "Surety.” The corporate body bound with and for Contractor for the full and complete performance of the Contract and payment of all debts pertaining to the Work.

M. "Work.” Work shall be understood to mean the furnishing of all labor, materials, equipment, services, utilities and other incidentals necessary to successful completion of the project and all the duties and obligations imposed upon Contractor by the Contract.

N. “Written Notice.” Shall be deemed to have been duly served if delivered in person to the individual or to the member of the firm or to an office of the corporation to whom it is intended, or if delivered to or sent by registered mail, to the last business address known to him who gives notice.

1.02 OWNER RESPONSIBILITIES

A. To the best of its abilities, the University will provide all relevant information relating to the project’s buildings, structures, and their nearby utility infrastructure, including underground utilities. This information is not guaranteed to be accurate, however, and must be field verified by the Contractor through inspection, investigation, utility locating, etc. MISS UTILITY will not locate underground utilities on University property.

B. Information or services under the Owner's control shall be furnished by the University with reasonable promptness to avoid delay in the orderly progress of the Work.

1.03 CONTRACTOR RESPONSIBILITIES

A. Contractor shall supervise and direct the work using his best skill and attention, and shall be solely responsible for all construction means, methods, techniques, sequences, and procedures and for coordinating all portions of the Work under the Contract.

B. Contractor shall be responsible to the University for the acts and omissions of Contractor employees, subcontractors and their agents and employees, and other persons performing any of the Work under the Contract.
C. Contractor shall not be relieved of its obligations to perform the Work in accordance with the Contract Documents by inspections, tests, or approvals required or performed by persons other than Contractor.

D. Contractor shall confine operations at the site to areas permitted by law, ordinances, permits, and the Contract Documents, and shall not unreasonably encumber the site with any materials or equipment.

E. Contractor shall design and coordinate its installation with sensitivity to aesthetics, particularly where exterior systems or components must be installed in a prominent location. The University has the right to reject or amend intended installations that are not considered within the intent of this guidance.

F. Cutting and Patching of Work

1. Contractor shall be responsible for all cutting, fitting, or patching that may be required to complete the Work or to make its several parts fit together properly in a workmanlike manner. Contractor shall clearly show on his installation drawings the locations proposed to be cut, penetrated, or otherwise altered, and provide details as to their final closure or condition.

2. Contractor shall not damage or endanger any portion of the Work or the work of the University or any separate contractors by cutting, patching or otherwise altering any work or by excavation. Contractor shall not cut or otherwise alter the work of the University or any separate contractor except with the written consent of the University and of such separate contractor. Contractor shall not unreasonably withhold from the University or any separate contractor its consent to cutting or otherwise altering the Work.

G. Indemnification

1. To the fullest extent permitted by law, Contractor shall indemnify, defend and hold harmless the University, the State of Maryland, Baltimore County, (if requested by the University), and their agents and employees from and against all claims, damages, losses, and expenses, including but not limited to attorney's fees, arising out of or resulting from the performance of the Work, provided that any such claim, damage, or loss or expense: (1) is attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property (other than the Work itself) including the loss of use resulting therefrom, and (2) is caused in whole or in part by any act or omission of Contractor, any subcontractor, anyone directly or indirectly employed by any of them, or anyone for whose acts any one of them may be liable, regardless of whether or not it is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, or otherwise exist as to any party or person described in this paragraph.

2. In any and all claims against the University or the State of Maryland or any of their agents or employees by any employee of Contractor, any subcontractor, anyone directly or indirectly employed by any of them, or anyone for whose acts any of them may be liable, the indemnification obligation under this paragraph shall not be limited in any way by any limitation on the amount or
type of damages, compensation, or benefits payable by or for Contractor or any subcontractor under workers’ compensation acts, disability benefit acts, or other employee benefit acts.

H. Security

1. Doors to the work areas and/or buildings shall be kept locked before, during and after normal work hours, except as necessary to provide reasonable access to the Work.

2. Contractor will provide, when necessary, temporary closures at door, window, and louver openings to secure the area and building from theft, damage, and weather.

3. Contractor shall be responsible for the security of the work area, and security deficiencies in the work area shall be immediately corrected as required by the University.

4. The TU Project Manager may, at his/her discretion, issue keys or access cards to Contractor for the duration of the job or require Contractor to sign out keys/cards at Facilities Management’s Work Control Office on a daily basis. Contractor must request access to other areas through the TU Project Manager. At closeout, Contractor must return all keys or access cards to the TU Project Manager. Contractor will be held responsible for all expenses related to the replacement of lost keys and all lock cylinders that can be opened with lost keys.

SECTION 2 - CONTRACT DOCUMENTS

2.01 CONTRACT DOCUMENTS

A. The Contract Documents are complementary unless specified otherwise in the solicitation notice; that which is called for by any one document shall be as binding as if called for by all.

1. Intent of the documents is to include all work necessary for proper completion of the project, ready for continual efficient operation. It is not intended, however, to include any work not properly inferable.

2. Clarification. Contractor shall obtain clarification of all questions as to intent of the Contract Documents, or any conflict between two or more items in the Contract Documents. If Contractor fails to obtain such clarification, University may direct that the Work proceed by any method indicated, specified, or required by the Contract Documents in the interest of maintaining the best construction practice, and such direction shall not constitute the basis of Contractor claims for extra costs.

3. Jargon. Work described in words that have a well-known technical or trade meaning shall be held to refer to such recognized standard use.
B. **University-Provided Drawings.** All University-provided drawings are given for general information only. These drawings reflect the as-built conditions of the buildings/structure and the campus infrastructure to the best of the University’s knowledge. The University cannot guarantee the accuracy of this information. Contractor shall inspect, investigate, and verify all field conditions prior to submission of its proposal.

C. **Contractor Drawings.** Contractor shall do no work without proper drawings and/or instructions that have been approved by the University. Drawings in general shall be drawn to scale and symbols used to indicate materials and architectural, structural, mechanical, and electrical requirements. Contractor shall keep on the job site a complete set of all drawings, specifications, shop drawings, schedules, etc., in good order and available to the University.

D. **Dimensions.** Contractor shall carefully check all dimensions prior to execution of the particular work affected and, if inaccuracies or discrepancies are found, consult the University prior to any construction or demolition. Dimensions for items to be fitted into constructed conditions at the job will be taken at the job and will be the responsibility of Contractor. The obvious intent of the documents, and obvious requirements dictated by conditions existing or being constructed, supersedes dimensions or notes that may be in conflict therewith. Whenever a stock size manufactured item or piece of equipment is specified by its normal size, it is Contractor’s responsibility to determine the actual space requirements for setting or entrance to the setting space. No extra will be allowed by reason of work requiring adjustments in order to accommodate a particular item of equipment.

2.02 SHOP DRAWINGS

A. Contractor shall submit for approval shop drawings, including setting drawings, and schedules as required by the University for the work of the various trades. These drawings shall be prepared in conformity with the best practice and standards for the trade concerned, with due regard for speed and economy of fabrication and erection.

B. All shop drawings must show the name of the project and the University contract number.

C. **Size of Drawings.** All shop drawings and details submitted for approval shall be printed on 24” x 36” drawing sheets or larger. Shop detail supplied on letter size (8 1/2” x 11”) sheets are acceptable for schedules and small details. An electronic copy is also required.

D. **Items For Which Shop Drawings Will Be Required.** Shop drawings are required for all items specifically fabricated for the Work, or when assembly of several items is required for a working unit. They must also be provided showing all points of connection, fastening, anchorage, cutting, penetrating, altering, etc. of any existing surfaces.

E. **Copies Required.** Contractor shall supply two (2) paper copies for the University’s Office of Facilities Management, in addition to such copies as Contractor may desire to be returned for its own use. An electronic copy shall also be submitted.
F. **Examination and Approval.** The University will examine shop drawings with reasonable promptness, noting desired corrections or granting approval or rejecting them.

G. **Field Dimensions and Conditions.** Contractor is solely responsible for the check of dimensions or existing conditions in the field.

H. **Resubmission.** When the University notes corrections or rejects shop drawings, Contractor shall resubmit with corrective changes.

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**SECTION 3 - SCOPE OF WORK**

3.01 **INTENT OF THE CONTRACT DOCUMENTS**

It is the intent of the Contract Documents to show all of the work necessary to complete the project.

3.02 **GENERAL CONDITIONS CONTROLLING**

In event of a conflict between these General Conditions and any other provision of the Contract Documents, these General Conditions shall prevail unless such other provision expressly provides to the contrary.

3.03 **DIFFERING SITE CONDITIONS**

A. Contractor shall promptly, and before such conditions are disturbed, notify the Procurement Officer in writing of: (1) Subsurface or latent physical conditions at the site, of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for in this contract. The Procurement Officer shall promptly investigate the conditions, and if he finds that such conditions materially differ and cause an increase or decrease in the cost of, or the time required for, performance of any part of the Work under this Contract, whether or not changed as a result of such conditions, an equitable adjustment shall be made and the contract modified in writing accordingly.

B. No claim by Contractor under this clause shall be allowed unless Contractor has given the notice required in A. above, provided, however, the time prescribed therefore may be extended by the University.

3.04 **SITE INVESTIGATION**

Contractor acknowledges that it has investigated and satisfied itself as to the conditions affecting the Work, including but not restricted to those bearing upon transportation, disposal, handling and storage of materials, availability of labor, water, electric power, roads and uncertainties of weather, river stages, tides or similar physical conditions at the site, the conformation and conditions of the ground, the character of equipment, and facilities needed preliminary to and during prosecution of the work. Contractor further acknowledges that it has satisfied itself as to the character, quality and quantity of surface materials or obstacles to be encountered insofar as this information is reasonably ascertainable from an inspection of the site, including all exploratory work done by the University, as well as from information...
presented by the drawings and specifications made a part of this contract. Any failure by Contractor to acquaint itself with the available information will not relieve it of responsibility for estimating properly the difficulty of cost of successfully performing this work. The University assumes no responsibility for any conclusions or interpretations made by Contractor on the basis of the information made available by the University.

3.05 CONDITIONS AFFECTING THE WORK

Contractor shall be responsible for taking steps reasonably necessary to ascertain the nature and location of the work or the cost thereof. Any failure by Contractor to do so will not relieve it of responsibility for successfully performing the work without additional expense to the University. Contractor agrees not to place any credence in any understanding or representation concerning conditions made by any University employee or agent prior to the execution of this contract, unless such understanding or representation is expressly stated in the contract.

3.06 CHANGES IN THE WORK [Intentionally omitted; see Exhibit A-2, Section 20]

SECTION 4 - CONTROL OF THE WORK

4.01 CONFORMITY WITH CONTRACT REQUIREMENTS

All work performed and all materials furnished shall be in conformity with the contract requirements.

4.02 ADJACENT WORK

A. The University shall have the right, at any time, to contract for and/or perform other work on, near, over, or under the work covered by this contract. In addition, other work may be performed under the jurisdiction of another state agency. Contractor shall cooperate fully with such other contractors and carefully fit its own work to such other work as may be directed by the University.

B. Contractor agrees that in event of dispute as to cooperation or coordination with adjacent contractors, the decision of the University will be binding. Contractor agrees to make no claims against the University or the State of Maryland for any inconvenience, delay, or loss attributable to the presence and operations of other contractors.

4.03 CONTROL BY THE CONTRACTOR

Contractor shall constantly maintain efficient supervision of the Work, using its best skill and coordinating ability. It shall carefully study and compare all drawings, specifications, and other instructions, and check them against conditions existing or being constructed on the project, and at once report any error, inconsistency, or omission discovered.

4.04 COOPERATION WITH UTILITIES

A. It is understood and agreed that Contractor has considered in its price all of the permanent and temporary utility appurtenances in their present or relocated
positions, and that no additional compensation will be allowed for normal delays, inconvenience, or damage sustained by him due to any interference, from the said utility appurtenances, the operation of moving them, or the making of new connections thereto if required by the contract documents.

B. Contractor shall be responsible for notifying all affected utility companies prior to performing any work on their utilities, and shall cooperate with them in achieving the desired results. Contractor shall be the responsible for all damage to utility facilities caused by Contractor's operations.

C. At points where Contractor's operations are adjacent to properties of railway, telegraph, telephone, water, and power companies, or are adjacent to other property, damage to which might result in expense, loss, or inconvenience, work shall not be commenced until Contractor makes all arrangements necessary for the protection thereof.

D. Contractor shall cooperate with owners of any underground or overhead utility lines in removal and rearrangement operations, so that these operations may progress in a reasonable manner, duplication or rearrangement is minimized, and services rendered by those parties are not unnecessarily interrupted.

E. In the event of interruption to utility services as a result of accidental breakage, or as a result of utility lines being exposed or unsupported, Contractor shall promptly notify the proper authority, and shall cooperate with said authority in restoration of service. No work shall be undertaken around fire hydrants until provisions for continued service are approved by the local fire authority.

F. Utility outages shall be kept to a minimum, and will be permitted only with the written approval of OFM. All requests for outages shall include identification of all areas to be affected by the proposed outage, and shall be made not less than 48 hours in advance of the need.

G. Contractor may use sanitary facilities located near the project site, if available. Should a nuisance in or an abuse of University facilities occur, and continue after notice from the University, then access to University facilities will be withdrawn, and Contractor shall provide its own facilities. Contractor shall keep all such facilities in clean and sanitary condition throughout the period of use, and repaint such facilities at the completion of the work, if required, at no cost to the University.

4.05 AUTHORITY AND DUTIES OF UNIVERSITY INSPECTORS

A. University inspectors are authorized to inspect all work done and all material furnished. Such inspections may extend to all or any part of the Work and to the preparation, fabrication, or manufacture of the materials to be used. The inspector is not authorized to revoke, alter, or waive any requirements of the contract, nor to approve or accept any portion of the complete project. He is authorized to call to Contractor's attention any failure of the work or materials to conform to the Contract. He is authorized to reject materials or suspend the work until any questions or issues are resolved. Inspectors shall perform their duties at such times and in such times and in such manner as will not unnecessarily impede progress on the Contract.
B. Inspector shall in no case act as foreman, or perform other duties for Contractor, nor interfere with management of the work by Contractor.

C. Any advice the inspector may give Contractor shall not be construed as binding the University in any way, or releasing Contractor from fulfilling the terms of the Contract. The duty of the inspector is to observe progress of the Work and report any deviations from the requirements of the Contract Documents; however, should the inspector fail to report any such deviation from the Contract requirements, Contractor is not released from its obligation to fulfill all terms of the Contract.

D. Where there is disagreement between Contractor and the inspector, the inspector will immediately direct the University's attention to the issues of disagreement, and if Contractor still refuses to make corrections, comply, or suspend work, the University will prepare and deliver in writing to Contractor a written order suspending the work. As soon as the inspector is advised of delivery of the shutdown order, the inspector shall immediately leave the site, and any work performed during the inspector's absence will not be accepted or paid for, and may be required to be removed and disposed of at Contractor expense.

4.06 INSPECTION OF THE WORK

A. All work, including the fabrication and source of supply, is subject to observation by the University and by those agencies required by law to inspect specific items.

B. Contractor shall provide facilities for access and inspection as required by the University.

C. If the specifications, the University's instructions, laws, ordinances, or any public authority require any work to be specially tested or approved, Contractor shall give the University timely notice of its readiness for inspection, and if the inspection is by another authority, the date fixed for such inspection. Inspections by the University shall be made promptly and, where practicable, at the source of supply. Any work covered without approval must, if required by the University, be uncovered for examination at Contractor's expense.

4.07 REMOVAL OF DEFECTIVE WORK

A. All work and materials that do not conform to the requirements of the Contract will be considered unacceptable.

B. Any unacceptable or defective work, whether the result of poor workmanship, use of defective materials, damage through carelessness, or any other cause shall be removed and replaced by work and materials that conform to the contract requirements, or shall be remedied otherwise in an acceptable manner authorized by the University.

C. If Contractor fails to comply promptly with any order made under this section, the University shall cause defective or unacceptable work to be remedied or replaced, and unauthorized work to be removed, and shall hold Contractor responsible for the costs thereof.
4.08 MAINTENANCE OF WORK DURING CONSTRUCTION

A. Contractor shall maintain the work during construction and until acceptance. This maintenance shall be continuous and effective, and prosecuted with adequate equipment and forces to the end that all parts of the Work are kept in satisfactory condition at all times, and protected from damage of any kind from external sources.

B. Particular attention shall be given to drainage, both permanent and temporary. Contractor shall use all reasonable precautionary measures to avoid damage or loss that might result from accumulations and concentrations of drainage water, and material carried by such waters and such drainage shall be diverted or dispensed when necessary to prevent damage to excavation, embankments, surfaces, structures, or property. Contractor shall take suitable measures to prevent erosion in all construction areas where existing ground cover has been removed. All such measures shall be in compliance with the requirements of any governmental entity having jurisdiction.

C. All costs of maintenance during construction and before final acceptance shall be included in the bid price; Contractor will not be paid additional amounts for such work.

D. If Contractor's work is halted by the University for failure to comply with the Contract, Contractor shall maintain the entire project as provided herein, and provide such ingress and egress for local residents or tenants adjacent to the project site, for tenants of the project site, and for the general public as may be necessary during the period of suspended work, or until Contractor has been declared in default.

E. On projects where traffic flow is maintained, Contractor shall be responsible for repair and restoration of all traffic damage to the work, either partially or totally completed, until the University accepts the work.

4.09 FAILURE TO MAINTAIN ENTIRE PROJECT

Contractor’s failure to comply with Section 4.4.08 shall result in notice by the University to comply with the required maintenance provisions. If Contractor fails to remedy unsatisfactory maintenance within 24 hours after receipt of such notice, the University will immediately proceed to maintain the project, and the entire cost of this maintenance will be charged to Contractor.

4.10 UNIVERSITY’S RIGHT TO DO WORK

If Contractor fails to prosecute the Work properly or to perform any provision of the Contract, the University, after three (3) days’ written notice to Contractor, may make good such deficiencies and deduct the cost thereof from the monies then or thereafter due to Contractor.

4.11 PARKING (See also Section 12.02)

A. Parking is allowed in only designated areas. Parking on sidewalks or unpaved areas is prohibited at all times.
B. All vehicles parked on Towson University property must strictly observe University parking regulations. Each vehicle parked on campus between 6 am and 8 pm, Monday through Thursday, and from 6 am to 3 pm on Fridays, must display a valid University permit unless parked at a paid meter. All fines for parking or other vehicle violations are the responsibility of Contractor.

C. This section applies to vendors, salespersons, company vehicles, and contractor employees’ personal vehicles. Long- and short-term permits are available, at designated rates, for vendors with contracts that require them to park regularly on the campus; see the parking website at http://wwwnew.towson.edu/adminfinance/auxservices/parking/ for permit rates and information to support preparation of bids and price proposals.

SECTION 5 - MATERIALS

5.01 GENERAL

A. All materials shall meet all quality requirements of the Contract. To expedite inspection and testing of materials, Contractor shall notify the University, in writing, of the sources from which Contractor proposes to obtain materials requiring approval, testing, inspection, or certification prior to incorporation into the work, as soon possible after notice of contract award.

B. Materials include all manufactured products and processed and unprocessed natural substances required for completion of the Contract. Contractor, in accepting the Contract, is assumed to be thoroughly familiar with the materials required and their limitations as to use, and requirements for connection, setting, maintenance, and operation. Whenever an article, material, or equipment is specified and a fastening, furring, connection (including utility connections), access hole, flashing closure piece, bed, or accessory is normally considered essential to its installation in good quality construction, such shall be included as if fully specified. Nothing in the specifications shall be interpreted as authorizing any work in a manner contrary to applicable laws, codes, or regulations.

C. Approval. All materials are subject to University approval for conformity with the specifications, quality, design, color, etc. No work for which approval is necessary shall be used until written approval is given. Approval of a subcontractor or supplier does not constitute approval of materials other than those included in the specifications.

D. New Materials. Unless otherwise specified, all materials shall be new. Old materials must not be used as substitutes for new, regardless of condition or repair, unless approved in writing by the University.

E. Quality. Unless otherwise specified, all materials shall be of the best quality of the respective kinds.

F. Samples. Contractor shall furnish all samples for approval as directed. Materials used shall be the same as the approved samples.
G. **Proof of Quality.** Contractor shall, if requested, furnish satisfactory evidence of the kind and quality of materials, either before or after installation, and shall pay for tests deemed necessary for substitutions as set forth in paragraph 5.03 of these General Conditions.

H. **Standard Specifications.** When no specification is cited and the quality, processing, composition, or method of installation of a thing is only generally referred to, then:

1. For items not otherwise specified below, the latest edition of the applicable American Society for Testing and Materials (ASTM) specification applies.

2. For items generally considered as plumbing and those items requiring plumbing connections, the applicable portions of the latest edition of the BOCA Code apply.

3. For items generally considered as heating, refrigeration, air conditioning, or ventilating, the applicable portions of the latest edition of the ASHRAE Handbook published by the American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc., apply.

4. For items generally considered as site work, the applicable portions of the Maryland State Highway Administration (SHA) Standard Specifications apply.

5. For items generally considered as electrical, the applicable provisions of the latest edition of the National Electrical Code apply.

6. For items generally considered as fire protection, the applicable portions of the latest edition of the National Fire Protection Association (NFPA) code apply.

I. Contractor is solely responsible for safeguarding its tools, materials, and equipment at the work site and elsewhere on the campus. The University shall not assume responsibility for vandalism and/or theft of Contractor materials, tools, or equipment.

J. Existing equipment and materials removed from the project shall become the property of the Contractor, who shall be responsible for removing same from the campus, absent a written agreement with the University. Contractor shall be responsible for proper handling of all materials removed for the purpose of recycling or salvage. Salvaged materials shall not be released to University staff without written approval from the Associate Vice President for Facilities Management. Under no circumstances shall Contractor provide salvage service on behalf of or for the benefit of University employees.

K. No asbestos, lead, or PCB-containing materials shall be used or installed on campus without prior written approval from the University's Department of Environmental Health & Safety (410-704-2949).

5.02 STORAGE AND HANDLING OF MATERIALS

A. Materials shall be stored and handled so as to assure the preservation of their quality and acceptability for the work. Stored materials, even though approved before
storage, may again be inspected prior to their use in the work. Stored materials shall be located so as to facilitate prompt inspection. Though not guaranteed, limited areas of the University may be used for some storage of materials and equipment, depending on the site location, time of the year, and the quantity of material/equipment; such storage areas shall be restored to their original condition at Contractor expense.

B. Contractor shall confine his tools and equipment and the storage of materials to the area designated by the TU Project Manager, and will not load or permit any part of the structure to be loaded with a weight that will endanger the safety of the structure or any part thereof.

C. Explosives
1. Explosives shall not be stored anywhere on University property.
2. Contractor may use explosives only upon written approval from the University. Approval will stipulate the time, place, and quantity of explosives to be used, and the manner of use.
3. Contractor assumes all responsibility for injury to persons or damage to property damage resulting from the use or transportation of explosives, and for complying with any and all ordinances, regulations, and restrictions related to the use of explosives.

D. Paints
1. Contractor shall not store oil-based paints or flammable liquids on the project site in containers larger than five (5) gallon size. Any liquid with a flash point of less than one hundred (100) degrees shall be contained in UL-approved safety cans; liquids with higher flash points shall be stored in rigid cans. Glass containers shall not be used.
2. Contractor shall remove all oily rags, waste, etc. from the work site at the close of each working day.

5.03 TESTS

A. If the Contract Documents, laws, ordinances, rules, regulations, or orders of any public authority having jurisdiction require any portion of the Work to be inspected, tested, or approved, Contractor shall give timely notice of its readiness so the University may observe such inspection, testing, or approval. Contractor shall bear all costs of such inspections, tests, or approval conducted by public authorities.

B. If the University determines that any work requires special inspection, testing, or approval in addition to that required by the Contract Documents, Contractor will, upon written authorization from the University, order such special inspection, testing, or approval, and give notice as provided in 5.06 A above. If such special inspection or testing reveals that work does not comply with the Contract, Contractor shall bear all costs of testing; otherwise the University shall bear such costs.
C. Contractor shall promptly secure all required certificates of inspection, testing, or approval and promptly delivered same to the University.

5.04 BUY AMERICAN STEEL

Only steel products made in the United States shall be used or supplied in the performance of the contract or any subcontract thereunder. Steel products include products rolled, formed, shaped, drawn, extruded, forged, cast, fabricated, or otherwise similarly processed from steel made in the United States. This requirement shall not apply if the University determines that the cost of such steel products is unreasonable or inconsistent with the public interest. The provisions of this paragraph shall not apply where they are in conflict with any Federal grant or regulation affecting this contract.

SECTION 6 - LEGAL RELATIONS AND RESPONSIBILITIES

6.01 LAWS TO BE OBSERVED

A. Contractor shall keep fully informed of all federal, state, and local laws, ordinances, and regulations, and all orders and decrees of bodies or tribunals having any jurisdiction or authority, which in any manner affect those engaged or employed on the Work, or in which any way affect the conduct of the Work. He shall at all times observe and comply with all such laws, ordinances, regulations, orders, and decrees. He shall protect and indemnify the University and its representatives against such claim or liability arising from or based on the violation of any law, ordinance, regulation, order, or decree, whether by himself or his employees or subcontractors.

B. Contractor must comply with the provisions of the Workmen’s Compensation Act and federal, state, and local laws relating to hours of labor.

C. The provisions of the Contract shall be governed by the Laws of Maryland.

D. Contractor shall give all notices and comply with all state and federal laws, ordinances, rules, and regulations bearing on the conduct of the Work as drawn and specified.

E. If Contractor observes that the drawings and specifications are at variance with any law, he shall promptly notify the University, and make all necessary changes as provided in the contract for changes in the work. If Contractor performs any Work knowing it to be contrary to such laws, ordinances, rules, and regulations, and without such notice to the University, he shall bear all costs arising therefrom.

6.02 PERMITS AND LICENSES [Intentionally omitted]

6.03 PATENTED DEVICES, MATERIALS, AND PROCESSES [Intentionally omitted; see Exhibit A-2, Section 26]

6.04 LAND, AIR, AND WATER POLLUTION

A. Contractor shall incorporate all permanent erosion control features into the work at the earliest practicable time. Temporary pollution control measures will be used to
correct unforeseen conditions that develop during construction, that are needed prior to installation of permanent pollution control features, or that are needed temporarily to control erosion that develops during normal construction practices, but are not associated with permanent control features on the project.

B. Contractor is advised that temporary pollution control may include measures outside the project site, where such work is necessary as a direct result of project construction. Contractor shall keep the University advised of all such off-site control measures undertaken; however, this shall not relieve Contractor of basic responsibilities for such work.

C. If Contractor fails to control erosion pollution and/or siltation, the University reserves the right to employ outside assistance or to use its own forces to provide the necessary corrective measures. All expenses incurred by the University in the performance of such duties for Contractor shall be the responsibility of Contractor.

D. Contractor must submit evidence to the University that governing federal, state, and local air pollution criteria are met. This evidence and related documents will be retained by the University.

E. If the performance of all or any part of the work is suspended, delayed, or interrupted by order of a court of competent jurisdiction as a result of environmental litigation as defined below, the Procurement Officer, at the request of Contractor, shall determine whether the order is due in any part to the acts or omissions of Contractor required by the University under the terms of the contract. If it is determined that the order is due in any part to acts or omissions of Contractor required by the Procurement Officer in the administration of the Contract, such suspension, delay, or interruption shall be considered as if ordered by the Procurement Officer under the Suspension of Work clause of the contract. The period of such suspension, delay, or interruption shall be considered reasonable, and an adjustment shall be made for any increase in the cost of performance of the contract (excluding profit) as provided that clause, subject to all the provisions thereof.

F. The term "environmental litigation" as used herein means a lawsuit alleging that the work will have an adverse effect on the environment, or that the University has not duly considered, either substantively or procedurally, the effect of the work on the environment.

6.05 CONTRACTOR'S LIABILITY INSURANCE

A. Contractor and each subcontractor shall maintain such insurance as will protect from claims under Workmen's Compensation Act, and the Federal Longshoremen's and Harbor Workers' Compensation Act, and the Federal Employers Liability Act by coverage with insurance companies or by methods acceptable to the State Insurance Commissioner and by no other method, for damages which may arise from operations under this contract, whether such operations be by Contractor or by any subcontractor or anyone directly or indirectly employed by either. All insurance except Workmen’s Compensation shall name the Towson University, the University System of Maryland, and the State of Maryland as additional insureds.
B. Contractor shall protect itself, the University, and the State from any claims for bodily injury, liability, and property damage liability.

C. Limits for bodily injury liability shall be not less than $1,000,000/2,000,000; i.e., $1,000,000 is the limit for injury per occurrence and $2,000,000 in the aggregate. The minimum limit for property damage liability shall be $1,000,000 per accident and $2,000,000 aggregate.

D. The above policies for bodily injury and property damage liability insurance shall be so written as to include contingent bodily injury and property damage liability Insurance to protect Contractor against claims from the operations of subcontractors.

E. Contractor's certificates of insurance containing evidence of the Hold Harmless Clause protecting the University and the State of Maryland shall be filed with the Procurement Officer and shall be subject to approval for adequacy of protection. No work shall be started at the site until appropriate certificates of insurance are filed with and approved by the Procurement Officer.

6.06 FIRE AND EXTENDED COVERAGE INSURANCE [Intentionally omitted; see Exhibit A-2, Section 38]

6.07 ASSIGNMENT [Intentionally omitted; see Exhibit A-2, Section 28]

6.08 SEPARATE CONTRACTS

A. The University reserves the right to let other contracts in connection with this Work. Contractor shall afford other contractors reasonable opportunity for the introduction and storage of their materials and the execution of their Work, and shall properly connect and coordinate his Work with theirs.

B. If any part of Contractor's work depends for proper execution or results upon the work of any other contractor, Contractor shall inspect and promptly report any defects in such work that render it unsuitable for such proper execution and results. Failure to so inspect and report shall constitute acceptance of the other contractor's work as fit and proper for the reception of Contractor's work, except as to the defects that may develop in the other contractor's Work after the execution of Contractor's work.

C. To insure proper execution of his subsequent work, Contractor shall measure work already in place and shall at once report to the University any discrepancy between the executed work and the drawings.

6.09 RELATIONSHIP OF CONTRACTOR TO PUBLIC OFFICIALS AND EMPLOYEES

A. In carrying out any of the provisions of the Contract, or in exercising any power or authority granted to them by or within the scope of the Contract, there shall be no liability upon the Procurement Officer or other authorized representatives of the University, it being understood that in all such matters they act solely as agents and representatives of the University.
B. The University may terminate the Contractor’s right to proceed under the Contract if the Procurement Officer finds that gratuities (in the form of entertainment, gifts, or otherwise) were offered or given by Contractor or any agent or representative of Contractor to any officer or employee of the University with a view toward securing a contract or securing favorable treatment with respect to the awarding or amending or the making of any determinations with respect to the performing of such contract. The facts upon which the Procurement Officer makes such findings may be reviewed in any competent court.

C. In the event the Contract is terminated as provided in paragraph B above, the University shall be entitled (1) to pursue the same remedies against Contractor as it could pursue in the event of Contractor’s breach of the contract, and (2) in addition to any other damages to which it may be entitled by law, to exemplary damages in an amount (as determined by the Procurement Officer) which shall be not less than three, nor more than ten times the costs incurred by Contractor in providing any such gratuities to any such officer or employee.

D. The rights and remedies of the University provided in this clause shall not be exclusive and are in addition to any other rights and remedies provided by law or under this contract.

E. Conflict of Interest. No official or employee of the State of Maryland whose duties as such official or employee include matters relating to or affecting the subject matter of this contract, shall, during the pendency and term of this Contract and while serving as an official or employee of the State, become or be an employee of Contractor or any subcontractor on this contract.

6.10 NO WAIVER OF LEGAL RIGHTS

A. The University and the State of Maryland shall not be precluded or estopped by any measurement, estimate, or certificate made either before or after the completion and acceptance of the work and payment therefore, from showing the true amount and character of the work performed and materials furnished by Contractor, or from showing that any such measurement, estimate, or certificate is untrue or is incorrectly made, or from showing that the Work or materials do not in fact conform to the requirements of the contract. The University and the State of Maryland shall not be precluded or estopped, notwithstanding any such measurement, estimate, or certificate, and payment from recovering from Contractor or his sureties, or both, such damage as it may sustain by reason of failure to comply with the terms of the Contract. Neither the acceptance by the University or any representative of the University, nor any payment for or acceptance of the whole or any part of the work, nor any extension of time, nor any possession taken by the University shall operate as a waiver of any portion of the contract or of any power herein reserved, or of any right to damages.

B. Waiver by the University of any breach of the Contract shall not be held to be a waiver of any other or subsequent breach.

6.11 COVENANT AGAINST CONTINGENT FEES [Intentionally omitted; see Exhibit A-2, Sec. 1]
6.12 ASSIGNMENT OF ANTITRUST CLAIMS

Contractor sells, transfers, and assigns to the University and the State of Maryland all rights, title, and interest of and in and to any causes of action arising at any time before the date of this assignment or during the performance of this contract under the Antitrust Laws of the United States, including Section 1 of the Sherman Act, and the Antitrust Law of Maryland relating to the purchase by him or the University or the State of Maryland of any products from any supplier or source whatever that are incorporated in structures built under the terms of this agreement. Contractor hereby certifies that the above causes of action are lawfully owned and that no previous assignment of same, has been made nor has the same heretofore been attached or pledged in any manner whatsoever.

6.13 FEDERAL PARTICIPATION [Intentionally omitted]

6.14 DISPUTES [Intentionally omitted; see Exhibit A-2, Section 27]

6.15 CLAIMS

A. Under no circumstances will overhead or profit be permitted as items of a claim, when such overhead or profit is for periods during which a "Stop Work" order is in effect due to an act, error, omission for which the contractor is responsible.

B. No profit or overhead that includes rental of equipment and the salaries of supervisory personnel will be allowed Contractor for stoppage of work when written notice of such stoppage, or impending stoppage, is not given sufficiently far in advance to prevent such stoppage.

C. No claim will be granted that includes cost of delays or work stoppage due to strikes lockouts, fire, unusually severe weather, avoidable casualties, or damage or delay in transportation for which the University or its agents are responsible; only time extensions, in accordance with Section 7.03 will be granted.

D. Contractor and the University agree that no prejudgment or post-judgment interest on any claims asserted by either party will be allowed.

E. No claim for damage caused by a delay will be allowed unless, within five (5) days of the act or omission causing the delay, Contractor notifies the University of the existence of the delay.

SECTION 7 - PROSECUTION AND PROGRESS OF THE WORK

7.01 NOTICE TO PROCEED

After the Contract has been executed, the University will issue Contractor a "Notice to Proceed" that stipulates the date on or before which Contractor is expected to begin work. The specified contract time shall begin on the day work (other than the erection of the inspector's office, construction stakeout, and mobilization) actually starts, or on the day stipulated in the Notice to Proceed, whichever is earlier. Any preliminary work started or materials ordered before receipt of Notice to Proceed shall be at contractor's risk.
7.02 SIGNS

A. General. The University shall provide one project sign for each major entrance to the project. The contractor shall be responsible for placement and maintenance of the sign(s).

B. Installation. Posts for sign(s) shall be supplied by the contractor and made of 4 x 6 inch construction grade lumber, pressure-preservative treated, 10 feet long. The sign(s) shall be bolted to the posts using at least two 2 inch bolts per post. Washers shall be used between the bolts and the sign faces and the posts and nuts. The posts shall be set into the ground to a depth of three feet, six inches with the bottom of the signs two feet six inches above the ground.

C. Removal. The University shall be responsible for removing the sign(s) after final acceptance of the work.

7.03 PROSECUTION OF THE WORK

A. All time limits in the Contract Documents are of the essence of the Contract.

B. The date of commencement of the work is the date established in a Notice to Proceed signed by the Procurement Officer.

C. If Contractor is delayed at any time in the progress of the work by any act or neglect of the University or any of its officers, agents, or employees, or by any separate contractor employed by the University, or by any changes ordered in the work, or by labor disputes, fire, unusual delay in transportation, unavoidable casualties, or by any cause which the Procurement Officer determines may justify any delay, then the contract time shall be extended for such time as the Procurement Officer may authorize.

D. It is expressly understood and agreed by and between Contractor and the University that the time for the completion of the work is a reasonable time, taking into consideration average climatic range and usual business conditions prevailing in the locality of the project.

7.04 PUBLIC CONVENIENCE AND SAFETY

Contractor at all times shall conduct the work in such a manner as to create the least practicable obstruction to all forms of traffic. The convenience of the general public, tenants, and of the residents along and/or adjacent to the improvement shall be respected. Material stored upon the project shall be placed so as to cause a minimum of obstruction to the public. Contractor shall, unless otherwise specified, provide and maintain in passable condition such temporary access roads and bridges as may be necessary to accommodate traffic diverted from the project under construction, or using the project under construction, and shall provide and maintain in a safe condition temporary approaches to, and crossings of, the project. Existing facilities scheduled to be removed, but which might be of service to the public during construction, will not be disturbed until other and adequate provisions are made. Fire hydrants on or adjacent to the project shall be kept accessible to fire apparatus at all times, and no material or obstruction shall be placed within 15 feet of any such hydrant. Work closed down for the winter or at any other times shall be left entirely accessible at all
points to fire apparatus. All footways, gutters, sewer inlets, and portions of the project the work under construction shall not be obstructed more than is absolutely necessary.

7.05 BARRICADES AND WARNING SIGNS

A. Contractor shall provide, erect, and maintain all necessary barricades, suitable and sufficient lights, danger signals, signs, and other control devices, and shall take all necessary precautions for the protection of the work and safety of the public. All highways and other facilities closed to traffic shall be protected by effective barricades, and obstructions shall be illuminated during hours of darkness with electric lights.

B. Contractor shall erect warning signs in advance of any place on the project where its operations may interfere with vehicular or pedestrian traffic, and at all other points where the new work crosses or coincides with an existing roadway or traffic lane(s). Such warning signs shall be constructed and erected in accordance with the FHWA Manual on Uniform Traffic Control Devices, or as directed.

7.06 PRESERVATION PROTECTION AND RESTORATION OF PROPERTY

A. Contractor shall continuously maintain adequate protection of its work from damage, and shall protect University property from injury or loss arising in connection with the Contract. Contractor shall repair, and shall indemnify the University against any such damage, injury, or loss, except such as may be directly due to errors in the Contract Documents, or caused by agents or employees of the University. Contractor shall adequately protect adjacent property as provided by law, and by the Contract Documents.

B. Contractor shall box all trees that are liable to injury by the moving, storing, and working up of materials. He shall use no tree for any attachment or anchorage.

C. Contractor shall erect and properly maintain at all times, as required by the conditions and progress of the Work, all necessary safeguards for the protection of workmen and the public, and shall post danger signs warning against the hazards created by such features of construction as protruding nails, hod hoists, well holes, elevator hatchways, scaffolding, window openings, stairways, and falling materials.

D. In any emergency affecting the safety of life or of the Work or of the adjoining property, Contractor, without special instruction or authorization, is permitted to act, at his discretion, to prevent such threatened loss or injury. If specifically instructed by the University to do work in an emergency, Contractor shall do the work and be compensated as outlined in Section 3.06.

7.07 PROGRESS SCHEDULE AND TIME

Preparation of Work Schedule. Contractor shall prepare a schedule setting forth dates for completing various portions of the work. Included among the tasks set forth on the schedule shall be the dates for submittals, and dates for the return of the approved submittals. The schedule shall be reviewed for approval of the time within which the University must evaluate Contractor submittals. Approval of Contractor's schedule does not constitute approval of the entire schedule, but merely an approval of that portion of the schedule that relates to the
review of submittals. If Contractor fails to prepare and submit to the University a schedule before the occurrence of a delay, then no claim for extra costs due to delay in the work shall be recognized or asserted.

7.08 PROGRESS PHOTOGRAPHS

Contractor shall submit to the University photographs, taken on or about the first of each month, showing the status of the Work. Contractor shall photograph all disputed items of work.

7.09 SUSPENSION OF THE WORK [Intentionally omitted; see Exhibit A-2, Section 63]

7.10 CONTRACTOR'S RIGHT TO STOP WORK OR TERMINATE CONTRACT

If the Work should be stopped under an order of any court, or other public authority, for a period of three (3) months, through no act or fault of the contractor, or of anyone employed by him, then Contractor may, upon seven (7) days' written notice to the Procurement Officer, stop work or terminate this contract.

7.11 UNIVERSITY'S RIGHT TO TERMINATE FOR ITS CONVENIENCE [Intentionally omitted; see Exhibit A-2, Section 66]

7.12 TERMINATION FOR DEFAULT--DAMAGES FOR DELAY--TIME EXTENSIONS [Intentionally omitted; see Exhibit A-2, Sections 25 and 65]

7.13 PARTIAL ACCEPTANCE

A. If during the construction of work the University desires to occupy any portion of the project, the University shall have the right to occupy and use those portions of the project which, in the opinion of the Procurement Officer, can be used for their intended purpose; provided that the conditions of occupancy and use are established and the responsibilities of Contractor and the University for maintenance, heat, light, utilities, and insurance are mutually agreed.

B. Partial occupancy shall in no way relieve Contractor of its responsibilities under the contract.

7.14 FAILURE TO COMPLETE ON TIME/LIQUIDATED DAMAGES

A. Time is an essential element of the Contract and the work shall be vigorously prosecuted until completion.

B. For each day that any work shall remain uncompleted beyond the time(s) specified elsewhere in the Contract, Contractor may be liable for liquidated damages in the amount(s) provided for in the solicitation, provided, however, that due account shall be taken of any adjustment of specified completion time(s) for completion of work as granted by approved change orders.
7.15 SUBSTANTIAL COMPLETION AND FINAL INSPECTION

A. When the work is substantially completed, the contractor shall notify the Procurement Officer that the work will be ready for final inspection and test on a definite date. Sufficient notice shall be given to permit the Procurement Officer to schedule the final inspection.

B. On the basis of the inspection, if the Procurement Officer determines that the work is substantially complete and the project can be occupied or used for its intended purpose, the Procurement Officer shall establish the date of substantial completion and shall state the responsibilities of the University and the contractor for maintenance, heat, utilities, and insurance, and shall fix the time for which the guarantee will begin.

7.16 CLEANING UP

Contractor shall at all times keep the construction area, including storage areas, free from accumulations of waste materials or rubbish and, prior to completion of the work, remove all rubbish from the premises and all tools, scaffolding, equipment, and materials not the property of the University. Contractor shall give special attention to any materials used on rooftops or exposed areas that may become windborne and be hazards, public nuisances, or litter on nearby grounds. Upon completion, Contractor shall leave the work and premises in a clean, neat, and workmanlike condition satisfactory to the Procurement Officer.

7.17 GUARANTEES

The contractor guarantees for a two (2) year period (unless another period is specified), commencing on the date fixed by the parties:

A. That the work contains no faulty or imperfect material or equipment or any imperfect, careless, or unskilled workmanship.

B. That all mechanical and electrical equipment, machines, devices, etc., shall be adequate for the use to which they are intended, and shall operate with ordinary care, and attention in a satisfactory and efficient manner.

C. That he will re-execute, correct, repair, or remove and replace with proper work, without cost to the University, any work found not be as guaranteed by this Section. The contractor shall also make good all damages caused to other work or materials in the process of complying with this Section.

D. That the entire work shall be water-tight and leak-proof in every particular.

7.18 NOTICE TO UNIVERSITY OF LABOR DISPUTES

A. Whenever the contractor has knowledge that any actual or potential labor dispute is delaying or threatens to delay the timely performance of this contract, the contractor shall immediately give notice thereof, including all relevant information with respect thereto, to the Procurement Officer.

B. The contractor agrees to insert the substance of this clause, including this Paragraph B., in any subcontract hereunder as to which a labor dispute may delay the timely
performance of this contract; except that each such subcontract shall provide that in
the event its timely performance is delayed or threatened by delay by any actual or
potential labor dispute, the subcontractor shall immediately notify his next higher tier
subcontractor, or the prime contractor, as the case may be, of all relevant
information with respect to such dispute.

SECTION 8 - PAYMENTS

8.01 CORRECTION OF WORK BEFORE COMPLETION

A. Contractor shall promptly remove from the premises all materials condemned as
failing to conform to the contract, whether incorporated in the work or not. Contractor
shall promptly replace and re-execute its own work in accordance with the contract
and without expense to the University, and shall bear the expense of making good all
work of other contractors destroyed or damaged by such removal or replacement.

B. If Contractor does not remove such condemned work and materials within a
reasonable time, fixed by written notice, the University may remove and store the
materials at Contractor expense. If Contractor does not pay the expense of such
removal within ten (10) days thereafter, the University may, upon ten (10) days
notice, sell such materials and shall account for the net proceeds thereof, after
deducting all the costs and expenses that should have been borne by Contractor.

8.02 PAYMENT OF INTEREST [Intentionally omitted; see Exhibit A-2, Section 50]

8.03 AUDITS BY THE STATE

A. Contractor agrees that the State or any of its duly authorized representatives shall,
until the expiration of three years after final payment under this contract have access
to and the right to examine any directly pertinent books, documents, papers, and
records of the contractor involving transactions related to this contract.

B. Contractor further agrees to include in all subcontracts hereunder a provision to the
effect that the subcontractor agrees that the University or any of its duly authorized
representatives shall, until the expiration of three years after final payment under the
subcontract, have access to and the right to examine any directly pertinent books,
documents, papers, and records of such subcontractor, involving transactions
related to the subcontract.

SECTION 9 - EMPLOYEES, SUBCONTRACTORS A WORK CONDITIONS

9.01 EMPLOYEES AND WORKMANSHIP

A. Qualification of Employees. Contractor shall employ only personnel thoroughly
trained and skilled in the tasks assigned on any portion of the work. Any employee
found to be unskilled or untrained shall be removed from the work.
B. **Licensed Employees.** When municipal, county, state, or federal laws require that certain personal (electricians, plumbers, etc.) be licensed, all such personal employed on the work shall be so licensed.

C. **Quantity of Labor.** Contractor shall employ on the work, at all times, sufficient personnel to complete the work within the time stated in the contract.

D. **Work Areas.** Contractor shall confine the operations of his employees to the limits as provided by law, ordinance, permits, or directions of the University. Generally, the work area will be the same as the "Limit of Contract" line indicated in the construction documents.

E. **Methods and Quality**

1. All workmanship shall be of good quality. Where the method of work or manner of procedure is not specifically stated in the contract documents, it is intended that the best standard practice shall be followed. Recommendations of the manufacturers of approved materials shall be considered part of these specifications and all materials shall be applied, installed, connected, erected, used, cleaned, and conditioned as so called for thereby.

2. All materials shall be accurately, assembled, set, etc., and when so required in good construction, shall be true to line, even, square, plumb, level, and regularly spaced, coursed, etc. Under no circumstances, either in new or old work, shall any material be applied over another which has not been thoroughly cleaned, sanded, or otherwise treated so as not to impair the finish, adhesion, or efficiency of the next applied item.

F. **Scheduling**

1. Contractor shall so schedule the Work as to ensure efficient and uninterrupted progress, and to minimize cutting and patching of new Work. All cutting, patching, and digging necessary to the execution of the Work is included.

2. Contractor shall so schedule the construction performed by each group or trade that each installation or portion of the construction shall member with and join with every other new or old Work as required for a complete installation, all according to accepted good construction practice.

G. **Superintendent.** Contractor shall keep on the Work, at all times during its progress, a competent English-speaking superintendent and any necessary assistants, all approved by the University prior to commencement of the Work. Contractor shall submit in writing to the University the name of the person it intends to employ as superintendent for the execution of this contract, with a statement of the proposed superintendent's qualifications, to be reviewed by the University and approved or rejected in writing. Persons who have previously proved unsatisfactory on work executed for the University or the State of Maryland, or who lack sufficient qualifications, will not be approved, and this procedure will be repeated. A single Contractor Superintendent may superintend two or more jobs located at the same
institution or nearby only when approved by the University in writing. The Superintendent shall represent the contractor, and all directions given to the Superintendent shall be as binding as if given directly to the Contractor. Important directions shall be confirmed in writing to the Contractor. Other directions shall be so confirmed upon written request. A Superintendent who proves unsatisfactory to the University shall be removed from the work, and Contractor shall submit a new Superintendent for approval as described above.

H. Discipline. Contractor shall at all times enforce strict discipline and good order among his employees and shall not employ or permit to remain on the work any unfit person. He shall enforce all instructions relative to use of water, heat, power, no smoking, and control and use of fires as required by law, and the University. Employees must not be allowed to loiter on the premises before or after working hours.

9.02 NON-DISCRIMINATION EMPLOYMENT POLICIES [Intentionally omitted; see Exhibit A-2, Section 44]

9.03 SUBCONTRACTS

A. Contractor shall, as soon as practicable and before execution of the contract, notify the University, in writing, of the names of subcontractors proposed for the principal parts of the work, and shall not employ any to which the University may object as incompetent or unfit.

B. Contractor shall be as fully responsible to the University for the acts and omissions of subcontractors, and of persons either directly employed by them, as for the acts and omissions of persons directly employed by Contractor.

C. Nothing contained in the Contract Documents shall create any contractual relation between any subcontractor and the University and nothing in the contract documents is intended to make the subcontractor a beneficiary of the contract between the University and the contractor.

9.04 RELATION OF CONTRACTOR AND SUBCONTRACTOR

A. Contractor agrees to bind every subcontractor, and will see that every subcontractor agrees to be bound by the terms of the Agreement, the General Conditions, the Drawings, and Specifications as far as applicable to its work, unless specifically noted to the contrary in a subcontract approved in writing by the University.

B. Contractor agrees to include the following provision in all subcontracts and supply contracts applicable to the work:

1. Subcontractor agrees to be bound to Contractor by the terms of the Agreement, General Conditions, Drawings, and Specifications, and to assume toward him all obligations and responsibilities that Contractor, by those documents, assumes toward the University.

2. Subcontractor agrees, upon completion of its work, to promptly pay all labor, material suppliers, vendors, subcontractors, and others, to permit simultaneous final payment by Contractor.
C. Contractor agrees to be bound to subcontractor by all the obligations that the University assumes to the Contractor under the Agreement, General Conditions, Drawings, and Specifications, and by all the provisions thereof affording remedies and redress to the Contractor from the University.

1. To pay the subcontractor to such extent as may be provided by the contract documents or the subcontract;

2. To pay the subcontractor on demand for his work or materials as far as executed and fixed in place, less the retained percentage;

3. To pay the subcontractor a just share of any fire insurance money received by Contractor; and

4. To give the subcontractor an opportunity to be present and to submit evidence in any matter involving his rights.

D. Prompt Payment of Subcontractors: This contract is subject to the provisions of COMAR 21.10.08. Contractor shall promptly pay subcontractor any undisputed amount to which the subcontractor is entitled. In the event Contractor fails to pay promptly, subcontractors may request remedy in accordance with COMAR 21.10.08. Contractor shall include in each subcontract a clause that contains substantially the same provisions as this clause.

E. Contractor and subcontractor agree that nothing in this section shall create any obligation on the part of the University to pay to or to see to the payment of any sums to any subcontractor.

9.05 PREVAILING WAGE RATES

Please be advised that Prevailing Wage Rates prescribed by the Maryland Department of Labor, Licensing and Regulation (DLLR) will apply to this project. The project specific wage rate instructions are incorporated into these General Conditions for Construction/Maintenance Contracts as Attachment A – Prevailing Wage Rate Instructions.

9.06 CONSTRUCTION SAFETY AND HEALTH STANDARDS

It is a condition of the Contract and shall be made a condition of each subcontract that neither Contractor nor any subcontractor shall require any laborer or mechanic employed in performance of the contract to work in surroundings or under working conditions which are unsanitary, hazardous, or dangerous to health or safety, as determined under construction safety and health standards, laws and regulations of the locality in which the work is done, the state, and the federal government.

SECTION 10 [Intentionally omitted]
SECTION 11 - ENVIRONMENTAL HEALTH AND SAFETY

11.01 STORM WATER POLLUTION PREVENTION/PROHIBITION OF ILLICIT DISCHARGES

No person shall cause or contribute discharge directly or indirectly into the Towson University municipal storm drain system or waterways any materials, including but not limited to pollutants or waters containing any pollutants that cause or contribute to a violation of applicable water quality standards, other than storm water.

Refer to **06-20.00 – University Policy on Storm Water Illicit Discharge Detection and Elimination** for additional information.

No person may improperly store, handle, use or apply any pollutant in a manner that will cause its exposure to rainfall, runoff and discharge into the Towson University municipal storm water drain system or campus waterways.

The commencement, conduct or continuance of any illegal discharge to the storm drain system is prohibited except as described:

A. The following discharges are exempt from discharge prohibitions:

   water line flushing or other potable water sources, landscape irrigation or lawn watering, diverted stream flows, rising ground water, ground water infiltration to storm drains, uncontaminated pumped ground water, foundation or footing drains (not including active groundwater dewatering systems), crawl space pumps, air conditioning condensation, springs, non-commercial washing of vehicles, natural riparian habitat or wet-land flows, swimming pools (if dechlorinated - typically less than one PPM chlorine), fire-fighting activities, and any other water source not containing pollutants.

B. Any discharges specified in writing by Towson University Environmental Health & Safety as being necessary to protect public health and safety.

C. Dye testing only with required verbal notification to Towson University Environmental Health & Safety [(410) 704-2949 or safety@towson.edu] prior to the time of the test.

D. The following discharges are exempt from discharge prohibitions: water line flushing or other potable water sources, landscape irrigation or lawn watering, diverted stream flows, rising ground water, ground water infiltration to storm drains, uncontaminated pumped ground water, foundation or footing drains (not including active groundwater dewatering systems), crawl space pumps, air conditioning condensation, springs, non-commercial washing of vehicles, natural riparian habitat or wet-land flows, swimming pools (if dechlorinated - typically less than one PPM chlorine), fire-fighting activities, and any other water source not containing pollutants.
11.02 PROHIBITION OF ILLICIT CONNECTIONS

The construction, use, maintenance or continued existence of illicit connections to the storm drain system is prohibited. This prohibition expressly includes, without limitation, any illicit connections made in the past. This is regardless of whether the connection was permissible under law or practices applicable or prevailing at the time of connection. A person is considered to be in violation if the person connects a line conveying sewage to the MS4, or allows such a connection to continue.

11.03 NOTIFICATION OF SPILLS OR ILLICIT DISCHARGES

Notwithstanding other requirements by law, as soon as any contractor has information regarding any known or suspected release of materials that result or may result in illegal discharges or pollutants discharging into storm water, the storm drain system, campus waterways said person shall take all necessary steps to ensure the discovery, immediate containment, and cleanup of such release. In the event of a release of hazardous materials or upon observing an illicit environmental discharge immediately contact the Towson University Police Department (TUPD) at (410) 704-4444. In the event of a release of non-hazardous materials, notify Towson University Environmental Health & Safety in person or by phone [(410) 704-2949] or e-mail [safety@towson.edu] no later than the next business day. Notifications in person or by phone shall be confirmed by written notice addressed and mailed to Environmental Health & Safety, Towson University, 8000 York Road, Towson, MD 21252 within three business days of the phone notice.

11.04 ENFORCEMENT

A. Enforcement for student violators will follow the TU Office of Student Conduct and Civility Educations Code of Student Conduct.

B. Enforcement for University employees (Faculty and Staff) shall follow the Towson University Policy for discipline or termination Policy No. 07.05.25 – Disciplinary Action for Employees.

C. Enforcement for Visitors (Non-TU Faculty, Staff, Students or Contractors)

D. Individuals or Contractors, depending on the nature and severity of the violation, may be referred to MDE for prosecution for violation of federal and state laws and regulations.

E. Any fines, penalties, environmental monitoring or remediation expenses, etc., resulting from the illicit discharge, will be violator’s responsibility.

F. During normal University business hours (Monday-Friday, 8am-4pm), contact EHS at (410) 704-2949 to report violations.

G. If the violator is still on the scene, they should also immediately contact TUPD at (410) 704-4444.

H. After normal duty hours, weekends and holidays, contact TUPD at (410) 704-4444 to report violations.
SECTION 12: OFM SUPPLEMENTAL CONDITIONS

12.01 STORAGE OF MATERIALS

The University has very limited storage space for any materials or equipment and may not be able to meet Contractor’s requests for such depending on the site location, time of year, and amount of equipment/materials.

12.02 PARKING

Parking must be coordinated prior to commencement of work. Designated parking areas will be provided for limited construction-related vehicles close to the work site; these may also require a fee-based permit. Contractor employees may need to use remote off-campus parking and carpool to the construction site. Contractor shall be responsible for securing any necessary permits for designated areas, for the duration of the project. Vehicles other than construction-related vehicles are not permitted on campus; boats, trailers, campers, etc. will be towed immediately, at vehicle owner’s expense.

12.03 INSPECTIONS

Inspections will be performed by the appropriate agencies as specified in the Contract documents. Towson University and independent inspection agencies, as required, will perform most required inspections. Other agencies that may be required for inspection are:

- Maryland Department of the Environment (MDE)
- State Fire Marshall

12.05 AMERICANS WITH DISABILITIES ACT (ADA) COMPLIANCE

All work performed shall be in compliance with current ADA regulations. Contractor shall notify the Owner of any deficiencies in design bearing on ADA compliance, prior to commencement of work.

12.06 VEHICULAR ACCESS

Contractors will use only the vehicle access routes approved by OFM prior to commencement of the project. Under no circumstances shall Contractor park or drive motor vehicles on grass or landscaped areas. Contractor shall bear all costs of repair or replacement of areas damaged by its vehicles.

12.07 CONTRACTOR MOTOR VEHICLES

Under no circumstances shall a contractor vehicle exceed 15 mph while on university property. Pedestrians have right of way at all times, with no exceptions. Any Contractor vehicle over 1 ton shall have operational back-up signals. Flat beds, box trailers and all 18-wheel vehicles shall be accompanied by an assistant during the back-up process to ensure the safety of pedestrians and property in the path of the vehicle.
12.08 CONTRACTOR’S EMPLOYEE BEHAVIOR

Contractor is responsible for its employees' behavior at all times. Unprofessional behavior will not be tolerated and will be cause for immediate removal of the employee(s) from campus property. Contractor employees should refrain from unsolicited conversation with the general campus public.

12.09 NOISE RESTRICTIONS

Due to the close proximity of residential communities and hospitals to University property, noise limitations are imposed during certain hours. Normal work hours (7:00am - 5:00pm) are not limited except as may be specified in regard to the adjacent classroom building schedules. When Contractor anticipates work before or after normal hours, it shall confirm with the University’s Project Manager that the work to be accomplished is within acceptable noise limits.

12.10 ELECTRICAL/MECHANICAL TIE-IN

Contractor shall coordinate all electrical and mechanical tie-ins through the University Project Manager at least 72 hours in advance. Contractor shall not enter any electrical panel for inspection, installation, or otherwise without the consent of the Project Manager. Where Contractor anticipates mechanical tie-in, he shall verify with the University Project Manager that existing valves and other control systems are functional. The University plumbing shop shall drain down all mechanical equipment.

12.11 WORK HOURS. Normal work hours shall be as follows:

- Weekdays: 7:00am - 4:00pm
- Weekends: 7:00am - 4:00pm, with written authorization
- Holidays: Only with advanced authorization

Deviations from normal work hours must be requested from the University's Project Manager not less than 72 hours prior to the start of anticipated work.

12.12 RADIOS

Playing of radios, CD players, etc. is not permitted on any construction site.

12.13 MAINTENANCE OF PROPERTY

Contractor is solely responsible for maintaining, at its expense, all property within the Limit of Disturbance (L.O.D.) or the established construction fence, which ever has the greater perimeter, including:

A. Cutting grass to a maximum 4" height and, where a construction or safety fence exists; trimming both sides.

B. Establishing and maintaining safety fence at the drip line of all trees and shrubs marked to remain.
C. Maintaining clean walkways and entrances to trailers used as site offices.

12.14 CONTRACT AND ADMINISTRATIVE PROTOCOL

Contractor and all contractor representatives shall clearly understand and strictly adhere to the following University protocols prior to work commencement:

A. All coordination between Contractor and Owner shall be through the University’s designated Project Manager. At no time shall Contractor request or demand support or assistance from the University’s maintenance department, trades shops, or grounds department. Failure to observe this protocol shall result in dismissal of Contractor’s superintendent from the site.

B. Coordination for submission of administrative and contractual documents shall be as outlined in pre-construction or work initiation meeting.
REQUEST FOR ADVERTISEMENT AND NOTICE TO PROCEED

Michelle Compton - Procurement Officer
Towson University
8000 York Road
Towson, MD 21252

Re: 7800 York Road 1st & 2nd Floor Renovation
Project No: TU-1949-SBR

Enclosed please find the Prevailing Wage Determination and Instructions for Contractors for the project referenced above.

Upon advertisement for bid or proposal of this project, you are requested to submit to this office the date and name of publication in which such advertisement appeared.

Once awarded, you are further directed to submit to this office, the NOTICE TO PROCEED for the project, complete with the date of notice, the name of the general contractor, and the dollar amount of the project. In addition, we ask that a representative of the prevailing wage Unit be invited to attend the Pre-Construction Conference.

Any questions concerning this matter may be referred to PrevailingWage@dllr.state.md.us

Sincerely,

Enclosures
Wage Determination
Instruction for the Contractor

Prevailing Wage Unit
The contractor shall electronically submit completed copies of certified payroll records to the Commissioner of Labor & Industry, Prevailing Wage Unit by going on-line to https://www.dllr.state.md.us/prevwage and following the instructions for submitting payroll information (NOTE: A contractor must register prior to submitting on-line certified payroll information).

If you have technical questions regarding electronic submittal, contact the Department at didliprevailingwage-dllr@maryland.gov.

All certified payroll records shall have an accurate week beginning and ending date. The contractor shall be responsible for certifying and submitting to the Commissioner of Labor and Industry, Prevailing Wage Unit all of their subcontractors’ payroll records covering work performed directly at the work site. By certifying the payroll records, the contractor is attesting to the fact that the wage rates contained in the payroll records are not less than those established by the Commissioner as set forth in the contract, the classification set forth for each worker or apprentice conforms with the work performed, and the contractor or subcontractor has complied with the provisions of the law.

A contractor or subcontractor may make deductions that are (1) required by law; (2) required by a collective bargaining agreement between a bona fide labor organization and the contractor or subcontractor; or (3) contained in a written agreement between an employee and an employer undertaken at the beginning of employment, if the agreement is submitted by the employer to the public body awarding the public work and is approved by the public body as fair and reasonable.

A contractor or subcontractor is required to submit information on-line on their fringe benefit packages including a list of fringe benefits for each craft employed by the contractor or subcontractor, by benefit and hourly amount. Where fringe benefits are paid in cash to the employee or to an approved plan, fund, or program, the contribution is required to be indicated.

Payroll records must be electronically submitted and received within 14 calendar days after the end of each payroll period. If the contractor is delinquent in submitting payroll records, processing of partial payment estimates may be held in abeyance pending receipt of the records. In addition, if the contractor is delinquent in submitting the payroll records, the contractor shall be liable to the contracting public body for liquidated damages. The liquidated damages are $10.00 for each calendar day the records are late.

Only apprentices registered with the Maryland Apprenticeship and Training Council shall be employed on prevailing wage projects. Apprentices shall be paid a percentage of the determined journey person’s wage for the specific craft.

Overtime rates shall be paid by the contractor and any subcontractors under its contracts and agreements with their employees which in no event shall be less than time and one-half the prevailing hourly rate of wages for all hours worked in excess of ten (10) hours in any one calendar day; in excess of forty (40) hours per workweek; and work performed on Sundays and legal holidays.

Contractors and subcontractors employing a classification of worker for which a wage rate was not issued SHALL notify the Commissioner of Labor & Industry, Prevailing Wage Unit, for the purpose of obtaining the wage rate for said classification PRIOR TO BEING EMPLOYED on the project. To obtain a prevailing wage rate which was NOT listed on the Wage Determination, a contractor or subcontractor can look on the DLLR webpage under prevailing wage.

Contractors and subcontractors shall maintain a valid copy of proper State and county licenses that permit the contractor and a subcontractor to perform construction work in the State of Maryland. These licenses must be retained at the worksite and available for review upon request by the Commissioner of Labor and Industry’s designee.

**Each contractor under a public work contract subject to Section 17-219 shall:**

1. Post a clearly legible statement of each prevailing wage rate to be paid under the public work contract; and
2. Keep the statement posted during the full time that any employee is employed on the public work contract.
3. The statement of prevailing wage rates shall be posted in a prominent and easily accessible place at the site of the public work.

**Penalty - Subject to Section 10-1001 of the State Goverment Article, the Commissioner may impose on a
person that violates this section a civil penalty of up to $50.00 per violation.

Under the Maryland Apprenticeship and Training Council requirements, consistent with proper supervision, training and continuity of employment and applicable provisions in collective bargaining agreements, a ratio of one journey person regularly employed to one apprentice shall be allowed. No deviation from this ratio shall be permitted without prior written approval from the Maryland Apprenticeship and Training Council.

Laborers may NOT assist mechanics in the performance of the mechanic's work, NOR USE TOOLS peculiar to established trades.

ALL contractors and subcontractors shall employ only competent workers and apprentices and may NOT employ any individual classified as a HELPER or TRAINEE on a prevailing wage project.

The State Apprenticeship and Training Fund (Fund) law provides that contractors and certain subcontractors performing work on certain public work contracts are required to make contributions toward apprenticeship. See §17-601 through 17-606, State Finance and Procurement, Annotated Code of Maryland. Contractors and subcontractors have three options where they can choose to make their contributions: (1) participate in a registered apprenticeship training program; (2) contribute to an organization that has a registered apprenticeship training program; or (3) contribute to the State Apprenticeship and Training Fund.

The Department of Labor, Licensing and Regulation (DLLR) is moving forward with final adoption of regulations. The regulations were published in the December 14, 2012 edition of the Maryland Register.

IMPORTANT: Please note that the obligations under this law will become effective on JULY 1, 2013. This law will require that contractors and certain subcontractors make contributions toward apprenticeship and report those contributions on their certified payroll records that they submit pursuant to the prevailing wage law.

The Department is offering outreach seminars to any interested parties including contractors, trade associations, and any other stakeholders. Please contact the Department at dlliprevailingwage-dllr@maryland.gov or (410) 767-2968 for seminar times and locations. In addition, information regarding this law will be provided at pre-construction meetings for projects covered by the Prevailing Wage law.

For additional information, contact:
Division of Labor and Industry
Maryland Apprenticeship and Training
1100 North Eutaw Street, Room 606
Baltimore, Maryland 21201
(410) 767-2246
E-Mail Address: matp@dllr.state.md.us.
The wage rates to be paid laborers and mechanics for the locality described below is announced by order of Commissioner of Labor and Industry.

It is mandatory upon the successful bidder and any subcontractor under him, to pay not less than the specific rates to all workers employed by them in executing contracts in this locality. Reference: Annotated Code of Maryland State Finance and Procurement, Section 17-201 thru 17-226.

These wage rates were taken from the locality survey of 2018 for Baltimore County, issued pursuant to the Commissioner's authority under State Finance and Procurement Article Section 17-209, Annotated Code of Maryland or subsequent modification.

**Note: If additional Prevailing Wage Rates are needed for this project beyond those listed below, contact the Prevailing Wage Unit. Phone: (410) 767-2342, email: prevailingwage@dllr.state.md.us.

Name and Title of Requesting Officer: Michelle Compton - Procurement Officer
Department, Agency or Bureau: Towson University
Project Number: TU-1949-SBR
Location and Description of work: Baltimore County: Perform renovation services on the 1st and 2nd floors of 7800 York Road.

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Date of Issue: Feb 12, 2019

BUILDING CONSTRUCTION

2/12/2019 2:37 PM
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**Laborer Group II**

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**Laborers Group I**

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**Fringe References As Noted:**


b. **Paid Vacations:** Employees with 1 year service - 1 week paid vacation; 2 years service - 2 weeks paid vacation; 10 years service - 3 weeks paid vacation.

**Incidental Craft Data:** Caulker, Man Lift Operator, Rigger, Scaffold Builder, and Welder receive the wage and fringe rates prescribed for the craft performing the operation to which welding, scaffold building, rigging, operating a Man Lift, or caulking is incidental.
These Informational Prevailing Wage Rates may not be substituted for the requirements of pre-advertisement or onsite job posting for a public work contract that exceeds $500,000 in value and either of the following criteria are met: (1) the contracting body is a unit of State government or an instrumentality of the State and there is any State funding for the project; or (2) the contracting body is a political subdivision, agency, person or entity (such as a county) and the State funds 50% or more of the project.

Modification Codes:

(AD) 17-209 Annual Determination from Survey Wage Data Received
(CH) 17-211 Commissioners’ Hearing
(CR) 17-208 Commissioners’ Review
(SR) 17-208 Survey Review by Staff

Each "Borrowed From" county is identified with the FIPS 3-digit county code unique for the specific jurisdiction in Maryland.

For additional information on the FIPS (Federal Information Processing Standard) code, see http://www.census.gov/datamap/fipslist/AllSt.txt

The Prevailing Wage rates appearing on this form were originally derived from Maryland’s annual Wage Survey. The Commissioner of Labor & Industry encourages all contractors and interested groups to participate in the voluntary Wage Survey, detailing wage rates paid to workers on various types of construction throughout Maryland.

A mail list of both street and email addresses is maintained by the Prevailing Wage Unit to enable up-to-date prevailing wage information, including Wage Survey notices to be sent to contractors and other interested parties. If you would like to be included in the mailing list, please forward (1) your Name, (2) the name of your company (if applicable), (3) your complete postal mailing address, (4) your email address and (5) your telephone number to PWMAILINGLIST@dllr.state.md.us. Requests for inclusion can also be mailed to: Prevailing Wage, 1100 N. Eutaw Street - Room 607, Baltimore MD 21201-2201.