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END OF SECTION
NOTICE TO BIDDERS

Notice is hereby given that sealed bids will be received:

By: The Trustees of Indiana University  
   Bloomington, Indiana

For: BL027 SWAIN WEST–ROOM 055 RENOVATION  
    Indiana University Bloomington  
    IU 20142395

At: Office of the Vice President for Capital Planning and Facilities  
    Indiana University  
    1800 North Range Road  
    Bloomington, IN 47408

Until: 2:00 P.M. (local time) on June 10th, 2015.

Bids received will then be publicly opened and read aloud. Bids received after that time will be returned unopened.

A Unified Bid is requested for all work in this project and will include all General, Mechanical, and Electrical work.

IU Project title and number shall be indicated on the sealed bid envelope as well as contractor’s name and address.

All bid proposals shall be in full accord with the Bidding Documents, which are on file with the Owner and may be examined by prospective Bidders at the following locations:

Capital Projects Business Office  
Indiana University  
1800 North Range Road  
Bloomington, IN 47408  
812-855-5294

Bidding documents will be available 05/12/2015 Please contact the Eastern Engineering Distribution Department, 9901 Allisonville Road, Fishers, Indiana 46038, Ph. 317-598-0661, www.iuplanroom.com for deposit and purchase information.

Each bid must be accompanied by a bid security for 5% of the total bid; the contractor’s written drug testing program, which must be in full compliance with IC 4-13-18-6; and the contractor’s
Minority and Women’s Business Enterprise Participation Plan, advising whether, and if so how, the contractor will utilize minority- and women-owned enterprises as subcontractors or material suppliers on the Project.

The Owner reserves the right to accept or reject any bid and to waive any irregularities in bidding. The Base Bid may be held for a period not to exceed sixty days before awarding Contracts. All Alternate Bids may be held for a period not to exceed ninety days before award and incorporation into the contract by proper Change Directive.

Should a successful Bidder withdraw his bid, or fail to execute a satisfactory Contract within ten days after notice of acceptance of bid, the Owner may declare the Bid Security forfeited as liquidated damages, not as penalty.

A Pre-bid meeting is scheduled for 2:00-3:00 pm local time on MAY 22, 2015. All interested parties should assemble at Swain West Room 238 on the Indiana University Bloomington campus.

The Trustees of Indiana University
By: MaryFrances McCourt, Treasurer
BID FORM
for
BL027 SWAIN WEST– ROOM 055 RENOVATION
Indiana University, Bloomington Campus
Bloomington Indiana
IU# 20142395

TO: The Trustees of Indiana University
Bloomington, Indiana

FROM:
Bidder's Name _____________________________________________
Address __________________________________________________________________
City and State _________________________________________________________
Phone Number ___________________________ Date ______________
FAX Number ___________________________ FEIN ______________

Indicate if your firm is a certified minority-owned business _____Yes _____ No
If “Yes”, please attach a copy of certification

FOR: Unified Bid to include General, Mechanical, and Electrical Construction Work

Bidders:

LUMP SUM BASE BID

The undersigned Bidder, with a complete understanding of existing conditions at the Project Site and a complete understanding of the Bidding Documents, including any Addenda acknowledged hereinafter, for BL 027 SWAIN WEST- ROOM 055 RENOVATION on the Indiana University BLOOMINGTON campus as prepared by UNIVERSITY ARCHITECT’S OFFICE hereby proposes to complete the project, in full and complete accordance with the requirements of the Bidding documents, for the LUMP SUM BASE BID PRICE of:

________________________________________________________________________

Dollars $ ______________
(written amount) (numerals)
MAJOR SUBCONTRACTORS

The Contractor proposes to utilize the following primary subcontractors for the work indicated. Indicate which are certified by the State of Indiana as an MBE or WBE company by circling the M/WBE after the name.

GENERAL: __________________________________________________ M/WBE

MECHANICAL __________________________________________________ M/WBE

PLUMBING __________________________________________________ M/WBE

ELECTRICAL: __________________________________________________ M/WBE

TAX EXEMPTIONS

The undersigned Bidder has informed himself and all his prospective sub-contractors and suppliers of the tax exempt status of the Owner, as set forth in the Special conditions, and therefore, has not included these taxes in his Lump Sum Base Bid price.

SUBSTITUTIONS

The undersigned Bidder has based his bid upon the materials, products, articles, equipment, brands, manufacturers and processes described in the Bidding Documents or upon approved equivalents. Proof of equivalency of substitutions is the responsibility of the Bidder, but the Architect/Engineer shall be the sole judge of equivalency. Proposed equivalent substitutions shall be equal in all respects to the requirements of the Bidding Documents, including but not limited to the design, quality, physical size, performance characteristics, strength, previous history of use, and to the method of installation, attachment, or connection to related or adjoining work. Determination of equivalency of proposed substitutions shall be by the Architect/Engineer, before the bid opening date, as described in paragraph entitled "Substitutions" in the Instructions to Bidders.

COMPLETION DATE

The Undersigned Bidder agrees to coordinate and expedite his work with all contractors and that this Work will be completed within _______ Calendar Days.
ASSIGNMENT OF COORDINATION

The undersigned Bidder agrees, to the assignment of Mechanical and Electrical work to the successful General Contractor for the responsibility of complete coordination of the work as stated in the Instructions to Bidders.

PERFORMANCE AND PAYMENT BOND

The undersigned Bidder agrees, if awarded the Contract, to deliver to the Owner a satisfactory Performance Bond, in the full amount (100%) of the total Contract price, not later than the date of execution of the contract. The cost of the Bond shall be included in the Lump Sum Base Bid contained in this Proposal.

SUPPLEMENTAL DOCUMENTS

Bid Security, State Form 96 (Revised 2005), Financial Statements, Written Drug Testing Program, which must be in full compliance with IC 4-13-18-6; Minority and Women’s Business Enterprise Participation Plan; Contractor Asbestos Certification; Asbestos Protocol for Contractors.

ADDENDA

The following Addenda have been received by the undersigned Bidder; and all costs resulting from these Addenda have been included in the preparation of this Bid Form:

  Addendum No. ________  Dated ________
  Addendum No. ________  Dated ________
  Addendum No. ________  Dated ________
  Addendum No. ________  Dated ________
  Addendum No. ________  Dated ________

SIGNATURES

1. When a Bidder is an Individual:

   __________________________________________________________________________
   Witness                                                      Bidder

   Date: __________________________  Address: __________________________
   __________________________
2. **When a Bidder is a Partnership:**

   Name of Partnership

   Date: ________________  Address: ____________________________
   ____________________________  ____________________________

   Partner  Partner

3. **When Bidder is a Corporation:**

   Name of Corporation

   Date: ________________  Address: ____________________________
   ____________________________

   By: ____________________________
   President

   Attest: ____________________________
   Secretary

   CORPORATE SEAL

   END
INSTRUCTIONS TO BIDDERS

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Revised January 9, 2013 - Articles 10.1, 18.2, 20.1
ARTICLE 1 - DEFINITIONS

1.1 Bidding Documents include the Notice to Bidders, Instructions to Bidders, the Bid Form, other sample bidding and contract forms and the proposed Contract Documents (as defined in the General Conditions), including any Addenda issued prior to receipt of bids.

1.2 All definitions set forth in the General Conditions of the Contract for Construction, AIA Document A201, (“GENERAL Conditions”) and Supplementary General Conditions, Indiana University Project Site Requirements or in other Contract Documents are applicable to the Bidding Documents.

1.3 Addenda are written or graphic instruments issued by the Owner’s Representative prior to the execution of the Contract which modify or interpret the Bidding Documents by addition, deletions, clarifications or corrections. Addenda become part of the Contract Documents when the Construction Contracts are executed.

1.4 A Bid is a complete and properly signed proposal to do the Work for the sum stipulated therein supported by data called for by the Bidding Documents.

1.5 Base Bid is the sum stated in the Bid for which the Bidder offers to perform the Work described as the base to which Work may be added or deducted for sums stated in Alternate Bids.

1.6 An Alternate Bid (or Alternate) is an amount stated in the Bid to be added to or deducted from the amount of the Base Bid if the corresponding change in project scope or materials or methods of construction described in the Bidding Documents is accepted.

1.7 A Unit Price is an amount stated in the Bid as a price per unit of measurement for materials or services as described in the Contract Documents.

1.8 A Bidder is one who submits a Bid for a prime contract with the Owner for the work described in the proposed Contract Documents.

1.9 A Sub-bidder is one who submits a bid to a Bidder for materials or labor for a portion of the Work.

1.10 A Day means a calendar day unless otherwise specified.

1.11 Contract Documents means these Instructions to Bidders, the General Conditions of the Contract for Construction Between Owner and Contractor, Supplementary General Conditions, Indiana University Project Site Requirements, Notice to Bidders, Bid Forms, Notice to Proceed, Drawings, Specifications, Construction Agreement, Addenda issued prior to execution of the Construction Agreement, , any other documents listed in the Agreement, approved Schedules (per General Conditions §3.10.4), and Modifications issued after execution of the Construction Agreement. A Modification is (1) a written amendment to the Contract signed by both parties, (2) Construction Change Directive or (3) a written order for a minor change in the Work issued by the Owner’s Representative.

ARTICLE 2 – MULTI-PRIME PROJECTS
WITH OR WITHOUT CONSTRUCTION MANAGER AS ADVISOR

2.1 Type of Bid

2.1.1 If this Project is bid as a multiple prime project with Construction Manager as Advisor,
Separate Contracts will be awarded to multiple Prime Contractors, as indicated below in Section 2.2 Division of the Work, and the requirements set forth in the remainder of this Article apply.

2.1.2 The Bid Proposals for each Prime Contract shall be on the basis of a Lump Sum Base Bid, plus furnishing supplementary information and supplementary documents as requested in the Bid Form.

2.2 Division of the Work

2.2.1 The Work of this Project has been divided into the following parts, for which Separate Contracts will be awarded:

( ) 3.1.1 General Construction Work
( ) 3.1.2 Mechanical Construction Work
( ) 3.1.3 Electrical Construction Work
( ) 3.1.4 Other ________________________

2.2.2 These Instructions to Bidders, Notice to Bidders, Bid Form, Agreement, Notice to Proceed, General Conditions of the Contract of Construction between Owner and Contractor, Supplementary General Conditions, Indiana University Project Site Requirements, Contract for Construction, Drawings and all the Specifications apply to each of the listed Prime Contracts. Also all Addenda issued during bidding apply to each of the listed Prime Contracts.

2.2.3 The scope of work for each Prime Contract is indicated on the Drawings and in the Specification Sections.

2.3 Assignment of Coordination and Authority to Approve Pay Applications

2.3.1 If the Owner has hired a Construction Manager as Advisor (“CM”) for this Project, the Owner will assign the coordination of the work of the all Prime Contractors to the CM and each Prime Contractors shall accept assignment of coordination as a condition of its Contract.

2.3.2 Said assignment of coordination of the work of the Prime Contractors to the CM is for the purpose of placing with one entity, namely the CM, the full and complete responsibility for coordinating and expediting all the Work required for the construction of this Project.

2.3.3 Each Prime Contractor shall provide the Owner, and not to the CM, with insurance, bonds, and such other documents as may be required under the terms of its contract and Indiana law.

2.3.4 The Owner will make monthly progress payments directly to each Prime Contractor under the terms set forth in the General Conditions and Supplementary General Conditions and Addenda thereto, and upon the written approval of the CM and Owner's Representative of each monthly payment request submitted.

2.3.5 If there is no CM for this Project, the Owner will assign the coordination of the work for all other Prime Contractors (including but not limited to the Contractors for Mechanical and Electrical Construction Work) to the General Contractor, and each Prime Contractors shall accept assignment of coordination as a condition of its Contract. The
duties assigned to the CM in Sections 2.3.2 through 2.3.4 shall be assigned to the General Contractor. On a multiple-Prime Project, the General Contractor shall report to the Owner’s Representative any circumstances known to it that will assist the Owner’s Representative in making a determination as to whether to withhold certification of an Application for Payment submitted by another Prime Contractor.

**ARTICLE 3 – SINGLE PRIME PROJECTS**

3.1 **Type of Bid**

3.1.1 If this Project is bid as a single prime project, the requirements set forth in the remainder of this Article apply.

3.1.2 The Bid Proposal shall be on the basis of a Lump Sum Base Bid, plus furnishing supplementary information and supplementary documents as requested in the Bid Form.

3.2 **Division of the Work and Coordination**

3.2.1 The Contractor shall be responsible for performance of or the provision via subcontracts of all work (general, mechanical, electrical) necessary for the completion of the work in full and complete accordance with the Bidding documents. The Contractor shall ensure that subcontractors at every tier comply with the same requirements to which the Contractor is obligated.

3.2.2 The Contractor shall ensure that the requirements set forth in Instructions to Bidders, all Addenda issued prior to receipt of Bids, the Bid Form, Agreement, General Conditions, Supplementary Conditions, and all Sections of Division 1 - General Requirements of the Specifications apply to each subcontract for work on this Project.

3.2.3 The scope of work for each Separate Contract is indicated on the Drawings and in the Specification Sections listed below:

3.2.4 The Contractor has the full and complete responsibility for coordinating and expediting all the Work, including that of all of its subcontractors, required for the construction of this Project.

**ARTICLE 4 - PROCUREMENT OF BIDDING DOCUMENTS**

4.1 Bidding Documents are on file and may be examined and/or obtained for bidding purposes as stated in the Notice to Bidders.

4.2 Bidding Documents used for bidding purposes shall remain the property of the Owner. Bidding Documents should be returned to Eastern Engineering within 21 days after the date set for opening of bids or deposit will be forfeited.

**ARTICLE 5 - EXAMINATION OF SITE AND BIDDING DOCUMENTS**

5.1 The site shall be carefully examined prior to bidding to ascertain the location of the work, existing conditions, and all other matters which may affect the work under this Contract. Each bidder by making his bid represents that he has visited the site and familiarized himself with the local conditions under which the Work is to be performed.

5.2 The Bidding Documents shall be carefully examined to ascertain the character, quality and
quantity of the work to be performed, of materials and items to be furnished, of equipment and facilities needed during construction, of utilities and of all other matters which may affect the work under the Contract. Each bidder by making his bid represents that he has read and fully understands the Bidding Documents.

5.3 Boring information, water levels, indications of surface and subsurface conditions and similar information given on the drawings or in the specifications are furnished only for the convenience of the Bidders. Logs of available subsurface explorations, borings and drawings of existing site conditions may be examined by arrangement with the Owner. The Owner, Owner’s Representative and their Consultants make no representation regarding the character and extent of the soil data or other surface or subsurface data and conditions to be encountered during the work and assume no responsibility and make no guarantee as to the accuracy or completeness of the information.

5.4 Each Bidder by careful examination, shall inform itself as to the nature and location of the work, the conformation of the ground, subsoil and ground water conditions, the character, quality and quantity of the materials to be encountered, the character of equipment and the facilities needed preliminary to and during the prosecution of the work, the general and local conditions and all other matters which can in any way affect the work. Each Bidder shall make its own deductions of surface and subsurface conditions which may affect methods or cost of construction of the work and Bidder agrees that, if it is awarded the Contract, it will make no claim for damages or other compensation, should it encounter conditions during the progress of the work different from those as calculated and/or anticipated by it.

ARTICLE 6 - QUALIFICATION OF BIDDERS

6.1 Each Bidder shall be thoroughly experienced in the work to be performed and capable of completing the work on schedule.

6.2 Each Bidder shall demonstrate that it is authorized to perform public works in the State of Indiana by submitting to the Owner a properly executed Contractor’s Bid for Public Work Indiana State Form 96 (Revised 2005).

6.3 Each Bidder shall demonstrate that it is financially able to complete the Contract for this Project by submitting its most recent full-year audited, or Independently Reviewed, financial statement and subsequent quarterly financial statements, if any. NOTE: This financial information is a required attachment to Indiana State Form 96.

ARTICLE 7 - INTERPRETATIONS AND ADDENDA

7.1 Each Bidder shall examine the Bidding Documents carefully and, not later than ten (10) days prior to the date of receipt of bids, shall make written request for interpretation or correction of any ambiguity, inconsistency or error therein which it may discover. Verbal questions will not be answered.

7.2 Request for interpretation, correction or clarification of the Bidding Documents shall be in writing to the Owner’s Representative.

7.3 Interpretation of the Bidding Documents will be given by the Owner’s Representative in the form of written Addenda no fewer than two (2) days before the bid opening date. Addenda will be distributed to each Bidder and shall become a part of the Bid Documents.

7.4 Bidders shall ascertain the status of Addenda two (2) days prior to the Bid opening date. Failure
of any Bidder to receive any Addenda shall not relieve the Bidder from the obligations of his bid, unless Bidder acknowledges in writing, prior to Bidding that he has not received the Addenda, in which case he is not liable therefore.

**ARTICLE 8 - SUBSTITUTIONS**

8.1 Where one or more specific materials, trade names, or articles of certain manufacturers are mentioned, it is done to establish a basis of durability, efficiency, appearance, and simplification of maintenance, and not for the purpose of limiting competition. Other materials or articles may be used if approved in writing by Owner. Approval may be obtained during the bidding period only. After bids are opened substitutions will not be considered. However, the establishment of proof that said "equal" product is equal to the product specified, shall be the responsibility of the Contractor if said equality is questioned by the Owner.

8.2 Any proposed substitution of equipment or materials for that which is not specified shall first be approved in writing by the Owner not less than seven (7) days prior to the date established for receipt of bids by the Owner.

**ARTICLE 9 - PRE-BID CONFERENCE**

9.1 A pre-bid conference will be held to answer Bidders’ questions regarding the Bidding Documents.

9.2 An Addendum will be issued confirming any information conveyed at pre-bid conference and no verbal response tendered during pre-bid conference shall have legal standing unless so confirmed by Addendum.

**ARTICLE 10 - WAGE SCALE**

10.1 Indiana Law (IC 5-16-7-1 & -2) provides that contractors and subcontractors pay common construction wages for projects estimated to be $350,000 or more in construction cost. All bids must be based on the common construction wage scale set for this work, if any, by the State Appointed Common Construction Wage Committee. If the estimated construction cost for this Project is under $350,000, the remainder of this Article 10 does not apply for this Bid.

10.2 The current State Appointed Common Construction Wage Committee’s determination of the common construction rate of wages for this project is included in the Specifications. The Contractor and its subcontractors shall comply with all applicable common construction wage requirements, including but not limited to providing wage scale certifications to the Owner.

10.3 If a new common construction wage scale is determined for the county in which the Project is located after bids are received and prior to contract award, the awarded Contractor will be expected to comply with the updated wage determination. Common construction wage scale determinations are available online at [www.in.gov/dol/2596.htm](http://www.in.gov/dol/2596.htm). (Project Owner = Indiana University).

10.4 The Bidder shall submit with its Bid a completed Statement of Wages to be Paid.

**ARTICLE 11 – ASBESTOS**

11.1 Unless expressly included in Project Specifications, Bidder shall not include in its bid price the cost of removal of the asbestos or asbestos containing materials (“ACM”).
11.2 Each Bidder is expected to familiarize itself with Section 15.B. of the Indiana University Project Site Requirements regarding the required protocol should asbestos or ACM be encountered on the Project.

ARTICLE 12 - DRUG FREE WORKPLACE:
DRUG TESTING PROGRAM

12.1 Owner maintains a drug free workplace, as provided in the Drug-free Workplace Act of 1988. By entering into a Contract with Owner, Contractor acknowledges compliance with this Act and will maintain a drug-free workplace.

12.2 The laws of the State of Indiana (IC 4-13-18 as amended) contain certain special provisions regarding drug testing of employees of public works Contractors and Subcontractors. Contracts entered into between a Contractor and the Trustees of Indiana University estimated to be in excess of $150,000.00 will be governed by these provisions. These provisions require, among other things, that a written plan for a program to test the Contractor’s employees for drugs, which must be in full compliance with I.C. 4-13-18 must be submitted with the bid.

12.3 The successful Bidder will be required to comply with all applicable provisions of I.C. 4.13.18 with respect to each Bidder’s Subcontractors, as the term “Subcontractor” is defined in the statute. In particular, the successful Contractor must require each of its subcontractors to furnish Contractor with the Subcontractor’s I.C. 4-13-18-6 compliant drug plan and requiring each subcontractor to implement the employee drug testing program described in the subcontractor’s plan.

12.4 The successful Bidder must submit, along with each application for payment under the Contract, an affidavit, dated and signed by the Contractor, substantially as follows:

This is to certify that in the performance of this Contract, neither the undersigned Contractor, nor (so far as the undersigned has knowledge) any of its Subcontractors, has violated the “Drug Testing Program” provision of the General Conditions of the Contract.

ARTICLE 13 - RECOMMENDED EMPLOYMENT OF APPRENTICES

13.1 Owner strongly recommends that Contractor employs apprentices from each building trades craft involved in the Project to the maximum extent feasible. In doing so, the Contractor shall consider whether such apprentices are indentured into a Joint Apprenticeship Training Program or other comparable bona fide apprenticeship training program, registered and certified with the U.S. Department of Labor, Bureau of Apprenticeship and Training and shall use as a guide the Apprenticeship Standards of the Labor-Management Contract for the appropriate jurisdictional area when determining the appropriate ratio of apprentices from each respective craft.

ARTICLE 14 – MINORITY AND WOMEN’S BUSINESS ENTERPRISES

14.1 MBE/WBE Participation Plan

Indiana University is committed to diversity and non-discrimination in all aspects of its operations. The Office of the President created the University Business Diversity Department and approved the Business Diversity Initiative to ensure that certified MBEs and WBEs are included in all invitations for quotes and bids, and that all prospective bidders are notified of Indiana University’s expectation for diversity, including but not limited to MBE/WBE
participation in procurement contracts for professional services, materials, supplies and equipment, and in contracts for the construction, architectural services, renovation or repair of university facilities and equipment. This expectation extends to all tiers of contractor utilization. Each Prime contractor should actively solicit and include certified minority- and women-owned subcontractors in bid submissions.

The Minority and Women’s Business Enterprise Participation Plan (form included in specifications) must be submitted with the bid. This Participation Plan will be considered during the proposal evaluation process.

Indiana University’s annual MBE and WBE participation goals parallel those set by the Indiana Department of Administration for its own business diversity efforts. The State MBE/WBE participation goals may be found at http://www.in.gov/idoa/2494.htm.

14.1.1 “Minority Business Enterprise” (MBE) means an individual, partnership, corporation, limited liability company, or joint venture of any kind that is owned and controlled by (1) or more persons who are (a) United States citizens; and (b) members of a racial minority group: African American, American Indians, Hispanics, Asian Americans, or other similar minority group as defined by 13 CFR 124.103

14.1.2 “Women’s Business Enterprise” (WBE) means an individual, partnership, corporation, limited liability company, or joint venture of any kind that is owned and controlled by (1) or more persons who are (a) United States citizens; and (b) whose gender is female.

In order to count toward participation goals, the MBEs and/or WBEs must be certified by the State of Indiana, the City of Indianapolis, or the Indiana Minority Supplier Development Council or other entity recognized by the state or federal government that provides certification of the sort.

Owner retains the discretion to hold payment, and/or to reject future bids submitted by the successful Contractor in the event that Contractor misrepresents either MBE/WBE participation in this Project, or its efforts to obtain MBE/WBE participation in this project, or fails to report MBE/WBE spend on this project.

14.2 Mandatory Tier II Reporting Requirement

The successful Contractor shall take all necessary and reasonable steps to ensure that MBE/WBEs have the maximum opportunity to compete for and perform work on this Contract. MBE/WBE utilization in the performance of this Contract must be reported monthly using the IU Online Tier II reporting System. Compliance with Owner’s Mandatory Tier II Reporting Requirement is a pre-condition for approval of pay applications. (For more information and training, see http://www.indiana.edu/~busdiv and click on Tier II Reporting.)

ARTICLE 15 BID SECURITY AND FORFEITURE

15.1 Bids shall be submitted with Bid Security in the form of a Bid Bond, Certified Bank Draft, or Cashier's Check, in the amount of five (5%) percent of the Bid, made payable to: "The Trustees of Indiana University, Bloomington, Indiana."

15.2 The Bid Security will be promptly returned to the unsuccessful Bidders, without interest, after signing of a Contract or the rejection of bids.

15.3 Should the successful Bidder refuse to enter into a Contract for the performance of the Work in
accordance with the terms of its Bid, the amount of the Bid Security shall be forfeited to the Owner as liquidated damages, not as a penalty.

**ARTICLE 16 - BIDDING PROCEDURES**

16.1 All Bids must be prepared in the format provided by the Owner and submitted in accordance with these Instructions to Bidders.

16.2 The Bid Form must include the following information:

- Alternate Proposals
- Unit Prices
- Major Subcontractors
- Completion Date
- Addenda Acknowledgment

16.3 In order to be complete, the Bid must include the following:

- Contractor’s Bid for Public Work – Form 96 (Revised 2005)
- Most recent full-year audited, or Independently Reviewed, financial statement AND subsequent quarterly financial statements
- Bid Bond – 5% of Bid
- Drug Testing Program, which must be in full compliance with Indiana Code 4-13-8
- Statement of Wages to be Paid
- Contractor Asbestos Certification
- Asbestos Protocol for Contractors
- MBE/WBE Participation Plan; Certification of MBE/WBE status if Bidder is itself an MBE/WBE

Check boxes have been included above to assist the Bidder to ensure that its bid will not be rejected based on its failure to meet these requirements.

16.4 One Bid Form and one copy of all other required documents shall be submitted, with all blank spaces appropriately filled in, with prices given in words and numerals, using ink or typewriter, with handwritten ink signature. The written prices shall govern where there is a discrepancy. Any modification shall be initialed.

16.5 Verbal proposals or modifications of proposals will not be considered for purposes of award of contract.

16.6 A Bid is invalid if it has not been deposited at the designated location prior to the time and date for receipt of bids indicated in the Notice to Bidders, or prior to any extension thereof issued to the Bidders.

16.7 No Bidder shall modify, withdraw or cancel its bid or any part thereof for sixty (60) days after the time designated for the receipt of bids in the Notice to Bidders.

16.8 Bids shall be delivered by hand, registered mail, or overnight service in a sealed opaque envelope with the project title and name and address of the Bidder clearly indicated on the outside of the envelope before 2 p.m. (local time) on the bid opening date to Indiana University, Office of the Vice President for Capital Planning and Facilities, 1800 North Range Road, Bloomington, IN 47408-9650.
ARTICLE 17 - BID OPENING

17.1 Bids will be opened publicly and read aloud. Bids received after the time scheduled for receipt of Bids will be returned unopened to the Bidder.

17.2 Bids shall be valid and binding for a period of not less than sixty (60) days after the bid opening date.

17.3 Bid opening date shall be as indicated in the Notice to Bidders, or as changed by Addendum. Bids shall be received no later than 2:00 p.m. local prevailing time.

ARTICLE 18 - REJECTION OF BIDS

18.1 The Bidder acknowledges the right of the Owner to reject any or all Bids and to waive any informality or irregularity in any Bid received.

18.2 The Bidder acknowledges and agrees that the Owner has the right to reject its bid if the bid is in any way incomplete, irregular, conditional, modified or obscure, or if the Bidder fails to furnish with its Bid any of the items identified in Sections 16.2 and 16.3.

ARTICLE 19 - SUBMISSION OF POST-BID INFORMATION

19.1 Upon request by the Owner’s Representative and Owner, a selected Bidder(s) shall, within 48 hours thereafter, submit the following:

19.1.1 A statement of costs for each major item of work included in its bid.

19.1.2 A designation of the work to be performed by the Bidder with its own forces.

19.1.3 A list of names of the subcontractors (firms doing work at the site) or other persons or organizations (including those who are to furnish materials or equipment) proposed for such portions of the work as may be designated in the bidding documents or, if no portions are so designated, the names of the subcontractors proposed for the principal portions of the work. The Bidder will be required to establish to the satisfaction of the Owner’s Representative and the Owner the reliability and responsibility of the proposed Subcontractors to furnish and perform the work described in the Sections of the Specifications pertaining to such proposed Subcontractors' respective trades. The Owner’s Representative will notify the Bidder in writing if either the Owner or the Owner’s Representative, after due investigation, has reasonable and substantial objection to any person or organization on such list. If the Owner or Owner’s Representative has a reasonable and substantial objection to any person or organization on such list, the Bidder shall submit the name of another person or organization, and continue to do so until all names of persons and organizations submitted are acceptable to the Owner and Owner’s Representative/Engineer.

Subcontractors and other persons and organizations proposed by the Bidder and accepted by the Owner and the Owner’s Representative must be used on the work for which they were proposed and accepted and shall not be changed except with the written approval of the Owner and the Owner’s Representative.
ARTICLE 20 – PERFORMANCE AND PAYMENT BOND, ESCROW AGREEMENT, AND OTHER REQUIRED DOCUMENTS

20.1 A Bidder selected as a Prime Contractor shall be required to provide a Performance and Payment Bond in the full amount (100%) of its Total Contract price. The Bond shall be made with a Surety Company with a rating of “A-“ or above in the most recent edition of the “A.M. Best’s Key Rating Guide.” The Bond shall be written in the form provided by the Owner, "Performance and Payment Bond," and shall be delivered to the Owner within thirteen (13) calendar days of the date of the Notice to Proceed. Said Bond shall remain in full force and effect for a period of at least two (2) years after date of final acceptance of the Project. The bond shall be issued in the name of The Trustees of Indiana University and filed with the Capital Projects Business Office.

20.2 The Bidder shall require the attorney in fact who executes the required Bond on behalf of the surety to affix thereto a certified and current copy of its power of attorney indicating the monetary limit of such power.

20.3 If awarded the Contract, the Bidder shall execute, along with the Construction Agreement, a formal Escrow Agreement as contemplated by Section 1 of the Supplementary Conditions.

20.4 If awarded the Contract, the Bidder shall provide to the Owner its Corporate Authority Signature Certificate and its W9 at the same time it returns the executed Construction Agreement.

ARTICLE 21 - AWARD OF CONTRACTS AND FORM OF AGREEMENT

21.1 The Owner will award the Contract(s) on the basis of the lowest and best bid(s) in accordance with Indiana law, utilizing any stated alternates accepted and shall issue to the successful Bidder(s) a Notice to Proceed.

21.2 No awards will be made on the day of opening bids.

21.3 The selected Bidder(s), upon notification, shall enter into written contracts by executing a Construction Agreement with the Owner; and, further, shall commence work within thirteen (13) days of the date of the Notice to Proceed.

21.4 The Construction Agreement shall be copy bound in with the Specifications.

ARTICLE 22 – MISCELLANEOUS

22.1 If the Owner has hired a Construction Manager for this Project, the successful Bidder will be required to execute the following Addenda with regard to insurance requirements: “The Contractor shall add the Construction Manager as an additional insured on all insurance coverages required for this Project and shall provide Construction Manager with documentation that this coverage has been obtained.”
CONTRACTOR'S BID FOR PUBLIC WORK – FORM 96

PART I
(To be completed for all bids. Please type or print)

Date: __________________________

1. Governmental Unit (Owner): ______________________________________________

2. County: ______________________________________________________________

3. Bidder (Firm): __________________________________________________________
   Address: ______________________________________________________________
   City/State: _____________________________________________________________

4. Telephone Number: _____________________________________________________

5. Agent of Bidder (if applicable): ___________________________________________

Pursuant to notices given, the undersigned offers to furnish labor and/or material necessary to complete
the public works project of __________________________________________________________________
(Governmental Unit) in accordance with plans and specifications prepared by ______________________________
_________________________________________________ and dated _____________________ for the sum of
____________________________________________________ $_____________________________________

The undersigned further agrees to furnish a bond or certified check with this bid for an amount specified in the
notice of the letting. If alternative bids apply, the undersigned submits a proposal for each in accordance with the
notice. Any addendums attached will be specifically referenced at the applicable page.

If additional units of material included in the contract are needed, the cost of units must be the same as
that shown in the original contract if accepted by the governmental unit. If the bid is to be awarded on a unit
basis, the itemization of the units shall be shown on a separate attachment.

The contractor and his subcontractors, if any, shall not discriminate against or intimidate any employee,
or applicant for employment, to be employed in the performance of this contract, with respect to any matter
directly or indirectly related to employment because of race, religion, color, sex, national origin or ancestry.
Breach of this covenant may be regarded as a material breach of the contract.

CERTIFICATION OF USE OF UNITED STATES STEEL PRODUCTS
(If applicable)

I, the undersigned bidder or agent as a contractor on a public works project, understand my statutory
obligation to use steel products made in the United States (I.C. 5-16-8-2). I hereby certify that I and all
subcontractors employed by me for this project will use U.S. steel products on this project if awarded. I
understand that violations hereunder may result in forfeiture of contractual payments.
ACCEPTANCE

The above bid is accepted this ____________ day of ________________, ________, subject to the following conditions: _______________________________________________________________________
________________________________________________________________________________________

Contracting Authority Members:
___________________________________  ___________________________________
___________________________________  ___________________________________
___________________________________  ___________________________________

PART II
(For projects of $100,000 or more – IC 36-1-12-4)

Governmental Unit: __________________________________________________
Bidder (Firm)            __________________________________________________
Date:                        __________________________________________________

These statements to be submitted under oath by each bidder with and as a part of his bid. Attach additional pages for each section as needed.

SECTION I EXPERIENCE QUESTIONNAIRE

1. What public works projects has your organization completed for the period of one (1) year prior to the date of the current bid?

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<tr>
<th>Contract Amount</th>
<th>Class of Work</th>
<th>Completion Date</th>
<th>Name and Address of Owner</th>
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2. What public works projects are now in process of construction by your organization?

<table>
<thead>
<tr>
<th>Contract Amount</th>
<th>Class of Work</th>
<th>Expected Completion Date</th>
<th>Name and Address of Owner</th>
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3. Have you ever failed to complete any work awarded to you? ______________ If so, where and why?
__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________

4. List references from private firms for which you have performed work.
__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________

SECTION II PLAN AND EQUIPMENT QUESTIONNAIRE

1. Explain your plan or layout for performing proposed work. (Examples could include a narrative of when you could begin work, complete the project, number of workers, etc. and any other information which you believe would enable the governmental unit to consider your bid.)

2. Please list the names and addresses of all subcontractors (i.e. persons or firms outside your own firm who have performed part of the work) that you have used on public works projects during the past five (5) years along with a brief description of the work done by each subcontractor.

3. If you intend to sublet any portion of the work, state the name and address of each subcontractor, equipment to be used by the subcontractor, and whether you will require a bond. However, if you are unable to currently provide a listing, please understand a listing must be provided prior to contract approval. Until the completion of the proposed project, you are under a continuing obligation to immediately notify the governmental unit in the event that you subsequently determine that you will use a subcontractor on the proposed project.

4. What equipment do you have available to use for the proposed project? Any equipment to be used by subcontractors may also be required to be listed by the governmental unit.

5. Have you entered into contracts or received offers for all materials which substantiate the prices used in preparing your proposal? If not, please explain the rationale used which would corroborate the prices listed.

SECTION III CONTRACTOR’S FINANCIAL STATEMENT

Attachment of bidder’s financial statement is mandatory. Any bid submitted without said financial statement as required by statute shall thereby be rendered invalid. The financial statement provided hereunder to the governing body awarding the contract must be specific enough in detail so that said governing body can make a proper determination of the bidder’s capability for completing the project if awarded.
SECTION IV CONTRACTOR’S NON–COLLUSION AFFIDAVIT

The undersigned bidder or agent, being duly sworn on oath, says that he has not, nor has any other member, representative, or agent of the firm, company, corporation or partnership represented by him, entered into any combination, collusion or agreement with any person relative to the price to be bid by anyone at such letting nor to prevent any person from bidding nor to include anyone to refrain from bidding, and that this bid is made without reference to any other bid and without any agreement, understanding or combination with any other person in reference to such bidding.

He further says that no person or persons, firms, or corporation has, have or will receive directly or indirectly, any rebate, fee, gift, commission or thing of value on account of such sale.

SECTION V OATH AND AFFIRMATION

I HEREBY AFFIRM UNDER THE PENALTIES FOR PERJURY THAT THE FACTS AND INFORMATION CONTAINED IN THE FOREGOING BID FOR PUBLIC WORKS ARE TRUE AND CORRECT.

Dated at ____________________ this ______________ day of __________________, _______

__________________________________________________________
(Name of Organization)

By________________________________________________________

__________________________________________________________
(Title of Person Signing)

ACKNOWLEDGEMENT

STATE OF ______________________) ) ss
COUNTY OF_____________________) ) ss

Before me, a Notary Public, personally appeared the above-named _________________________________ and swore that the statements contained in the foregoing document are true and correct.

Subscribed and sworn to before me this ____________ day of ___________________, ________.

____________________________________________
Notary Public

My Commission Expires:_____________________

County of Residence:_______________________
BID OF

________________________________________________________ (Contractor)

________________________________________________________ (Address)

_____________________________________________

FOR

PUBLIC WORKS PROJECTS

OF

________________________________________________________

________________________________________________________

________________________________________________________

________________________________________________________

Filed ________________________________, _______

Action taken __________________________________

__________________________________________
MINORITY AND WOMEN'S BUSINESS ENTERPRISE PARTICIPATION PLAN

The Bidder/Firm is expected to submit with its bid/proposal a Minority and Women’s Business Enterprise Participation Plan. Minority Business Enterprise (MBE) and Women’s Business Enterprise (WBE) are defined below. In this Plan, the Bidder/Firm must show that there are certified racial minority- and/or woman-owned enterprises participating in the project. Participation may be as a subcontractor or second tier participation with common suppliers (e.g., office suppliers, courier services). The Bidder/Firm must indicate the name of the MBE/WBE(s) with which it will work; the contact name and phone number at the MBE/WBE(s); the service supplied by the MBE/WBE(s); and the specific dollar amount from the project that will be directed toward each MBE/WBE. Please note: If the Trade is an overhead item for your entire business, please calculate the proportion of the business that will actually apply to the project in question.

Documentation of the Bidder’s/Firm’s good faith effort to meet the participation goal must be submitted at bid time; see Page 3 of this form.

Failure to provide the Plan and evidence of a good faith effort at the time of bid/proposal submission will result in the rejection of the bid/proposal. Indiana University reserves the right to verify all information included in the Minority and Women’s Business Enterprise Participation Plan before making final determination of the Bidder’s/Firm’s responsiveness and responsibility.

By submission of the bid/proposal, the Bidder/Firm thereby acknowledges and agrees to be bound by the IU Business Diversity Initiative. Questions involving the Minority and Women’s Business Enterprise Participation Plan should be directed to the IU Business Diversity Department at 317/278-5384.

Definitions:

a. “Minority Business Enterprise” (MBE) means an individual, partnership, corporation, limited liability company, or joint venture of any kind that is owned and controlled by (1) or more persons who are (a) United States citizens; and (b) members of a racial minority group: African American, American Indians, Hispanics, Asian Americans, or other similar minority group as defined by 13 CFR 124.103

b. “Women’s Business Enterprise” (WBE) “Minority Business Enterprise” (MBE) means an individual, partnership, corporation, limited liability company, or joint venture of any kind that is owned and controlled by (1) or more persons who are (a) United States citizens; and (b) whose gender is female.

MBE/WBE PARTICIPATION PLAN

PROJECT # _____________________________ BID/PROPOSAL DUE DATE _____________________

PROJECT NAME _______________________________________________________________________

BIDDER/FIRM _________________________________________________________________________

ADDRESS ____________________________________________________________________________

CITY/STATE/ZIP ______________________________________________________________________

PHONE: (        ) ______________________________________________________________________

EMAIL:  ______________________________________________________________________________

URL: ________________________________________________________________________________
The following certified minority- and/or women-owned firms will be participating in the project according to the following schedule. Indicate whether each firm is an MBE or a WBE by circling either MBE or WBE below. Submit each firm’s certification document, within 48 hours post-bid, to the Owner via fax @ 812-855-5635.

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<tr>
<th>MBE/WBE</th>
<th>TRADE</th>
<th>AMOUNT</th>
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If additional room is necessary, please attach a separate page.

By my signature, I certify that the above statements are true and accurate, all as of the date below. I also understand that any changes to this plan must be approved by Indiana University and documented by Construction Change Directive.

Agent of Bidder

Date
MBE and WBE Participation Plan (Continued)

BIDDER/FIRM _______________________________  PROJECT # _____________________________

PROJECT NAME ______________________________________________________________________

Describe below your efforts to obtain minority and women’s business enterprise participation for this project.
Be sure to attach a copy of all solicitation efforts, e.g., ads that were published or networking events, etc.

________________________________________________________________________________

________________________________________________________________________________

________________________________________________________________________________

List below the MBE/WBE contractors you individually contacted to request a quote for this project.
Check all that apply:

<table>
<thead>
<tr>
<th>Minority firms contacted (company name and commodity)</th>
<th>Method of contact (i.e., phone number, fax number, email address, mailing address AND contact name)</th>
<th>MBE</th>
<th>WBE</th>
<th>Quote Received – Not low</th>
<th>No response</th>
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If extra space is necessary, please attach additional pages.

PAGES 1, 2, AND 3 OF THIS DOCUMENT MUST BE SUBMITTED WITH THE BID
ATTACHMENT TO COMMON CONSTRUCTION WAGE SCALE
FOR INDIANA UNIVERSITY CONSTRUCTION PROJECTS

A common construction wage scale has been determined for this project and is included in the specifications. All bids must be based on said common construction wage scale.

The STATEWIDE CLASSIFICATIONS AND DESCRIPTIONS FOR DETERMINING RATES FOR BUILDING CONSTRUCTION as established by the State Department of Labor and Labor Unions in Indiana is available from the Capital Projects Business Office (812-855-5294) to assist all contractors in determining classifications for appropriate wage rates.

Should a contract not be awarded within 90 days from the date wage rates are established, the successful bidder will be requested to submit documentation to certify payment of any revised wage rate at no change in the original bid amount.
Asbestos Protocol for Contractors
Communication of Hazards

Asbestos-containing materials (ACM) exist in many buildings constructed prior to January 1, 1981. Pursuant to the OSHA Construction Industry Asbestos Standard 29 CFR 1926.1101, “Communication of Hazards,” a building owner is required to inform contractors doing demolition or renovation of the presence, location and quantity of ACM found at the work sites in its buildings. The IU Environmental Health and Safety Department (EHS) performs the asbestos inspection of buildings on the IU campuses and, if necessary, will conduct or oversee the safe removal of all known and accessible ACM prior to renovation or demolition work.

EHS generates a post-inspection Asbestos Notice of each work site, which identifies building materials that are visible or otherwise known to be present at the site at the time of inspection as being “Non-ACM” or “ACM.”

The inspection, and therefore the information contained in the notice, is limited to what is visible to the inspector at the time of the inspection. This means that during the course of construction work, it is possible to encounter ACM that was not identified on the notice because of the physical limitations on the Asbestos Inspector’s ability to see and identify ACM at the time of the inspection. Contractors are expected to have knowledge of the types and likely locations of ACM generally found in building materials and to be able to make visual identification of ACM and must provide documentation that each employee has attended Asbestos Awareness Training within the last calendar year.

Under no circumstances are contractors permitted to disturb ACM. Contractors are required to stop work immediately upon discovering suspected ACM and to make a report to the owner’s Project Manager. The Project Manager may direct the contractor to the EHS office if a disturbance has occurred and/or to coordinate additional surveying.

For the Contractor

I understand and agree that the employees and agents of my company and/or the employees and agents of my company’s subcontractor(s) are prohibited from disturbing ACM.

I understand and agree that, upon the discovery of ACM or suspected ACM at the worksite, work shall be stopped immediately and a report of the discovery made to the owner’s Project Manager. I agree that my employees, agents and/or the employees and agents of my subcontractor(s) will comply with the directions of the Owner’s Project Manager with regard to responding to the discovery or disturbance of ACT.

I understand and agree that failure on the part of my employees and agents and/or the employees and agents of my subcontractor(s) to comply with the above requirements may result in fines being imposed against my company or the owner, or both, by the Indiana Department of Environmental Management (IDEM), or by other federal, state, county or municipal authorities. I agree I will reimburse the owner for any costs incurred by the owner based on violations of this protocol by my employees or agents and/or the employees or agents of my subcontractor(s), including but not limited to fines, penalties, attorneys fees and/or court costs.

I have read and understand these requirements:

Contractor Signature                Date                IU Project Number

Printed Name                             IU Project Title
PERFORMANCE AND PAYMENT BOND

KNOW ALL MEN: That we

(Here insert the name and address or legal title of the Contractor) hereinafter called the Principal, and

hereinafter called the Surety or Sureties, are held and firmly bound unto The Trustees of Indiana University, hereinafter called the Owner, in the sum of:

for payment whereof the Principal and the Surety or Sureties bind themselves, their heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has, by means of a written Agreement, dated: ______________ entered into a contract with the Owner for

a copy of which Agreement is by reference made a part hereof:

NOW THEREFORE, the condition of this Obligation is such that, if the Principal shall faithfully perform the Contract on its part and shall fully indemnify and save harmless the Owner from all cost and damage which the Owner may suffer by reason of failure to do so and shall fully reimburse and repay the Owner all outlay and expense which the Owner may incur in making good any such default,

and further that, if the Principal shall pay all persons who have contracts directly with the Principal for labor or materials, and all employees, persons, firms, or corporations who have just claims and demands for labor or materials furnished or used in connection with the prosecution of the work under the contract, failing which such persons shall have a direct right of action against the Principal and Surety under this obligation, subject to the Owner’s option and priority, then this obligation shall be null and void, otherwise it shall remain in full force and effect.

The said surety for value received 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 them, shall in any way affect its obligations on this 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.

PROVIDED, however, that no suit, action or proceeding by reason of any default whatever shall
be brought on this Bond after two years from the date of final payment.

AND PROVIDED, that any alterations which may be made in the terms of the Contract, or in the
work to be done under it, or the giving by the Owner of any extension of time for the
performance of the Contract, or any other forbearance on the part of either the Owner or the
Principal to the other shall not in any way release the Principal and the Surety or Sureties, or
either or any of them, their heirs, executors, administrators, successors or assigns from their
liability hereunder, notice to the Surety or Sureties of any such alterations, extension or
forbearance being hereby waived.

Signed and Sealed this __________ day of ____________________ 20 ______

In presence of:

________________________________________)  _______________________________(SEAL)

)As to
________________________________________

________________________________________)  _______________________________(SEAL)

)As to
________________________________________

________________________________________)  _______________________________(SEAL)

)As to
________________________________________

________________________________________)  _______________________________(SEAL)
CONSTRUCTION AGREEMENT
FOR PROJECTS WITH A
CONSTRUCTION MANAGER

This contract made the day of 20, by and between , ("Contractor") and The Trustees of Indiana University, Bloomington, Indiana ("Owner").

Article I, Scope of Work: The Contractor shall perform all labor, furnish all materials and equipment necessary to complete the contract for work, all in accordance with the Contract Documents prepared by .

Titled: project title
IU campus
city, Indiana
IU project number

which Contract Documents are made a part of this contract and shall do everything required by this Agreement and Contract Documents.

Article II, The Contract Documents: The Contract Documents are the Notice to Bidders, Instructions to Bidders, Bid Forms, the General Conditions of the Contract for Construction Between Owner and Contractor, Supplementary General Conditions, Indiana University Project Site Requirements, Notice to Proceed, Drawings, Specifications, this Construction Agreement, Addenda issued prior to execution of this Construction Agreement, any other documents listed in this Construction Agreement, approved Schedules (per General Conditions §3.10.4), and Modifications issued after execution of this Construction Agreement. A Modification is (1) a written amendment to the Contract signed by both parties, (2) Construction Change Directive or (3) a written order for a minor change in the Work issued by the Owner’s Representative.

The following is an enumeration of the Specifications and Drawings:

Specifications
Owner - Contractor Agreement
Conditions of the Contract (General and Special)
Specifications Sections of Divisions 0 through 33, all as listed on the Table of Contents in the Specification.

Drawings

All as listed on the Title Sheet of the Drawings.
**Article III, Contract Price:** The Owner shall pay to the Contractor for the performance of this contract, subject to any additions or deductions provided herein, in current funds as follows:

Base Bid $ 
Alternate $ 
Contract amount $ 

**Article IV, Time of Completion:** The work to be performed under this Contract shall be commenced at once and shall be substantially completed by _______________.

**Article V, Required Documents:** Along with this executed Construction Agreement, the Contractor shall provide the Owner with an executed Escrow Agreement, its Corporate Authority Signature Certificate and its W9. The Contractor acknowledges and agrees that the insurance documentation required by the General Conditions, Section 3.1.5, was to be submitted to the Owner within thirteen (13) calendar days of the date of the Notice to Proceed.

**Article VI, Assignment of Coordination:** The coordination of the work of all contractors shall be assigned to the Construction Manager hired by the Owner for this Project, namely ______________________________. Said assignment of coordination of the work of all Contractors to the Construction Manager is for the purpose of placing with the Construction Manager responsibility for coordination of and expediting all the work required for the construction of this Project and for the certification of applications for payment. The Contractor expressly accepts this assignment of coordination as a condition of its Contract.

**Article VII, Terms of Payments:** The Owner will make monthly progress payments directly to the Contractor under the terms set forth in the General Conditions and Conditions and Addenda thereto, and upon the written approval of the Owner's Representative for each monthly payment request submitted. The Construction Manager hired by the Owner for this Project is authorized to and shall report to the Owner’s Representative any circumstances known to it that will assist the Owner’s Representative in making a determination as to whether to withhold certification of an Application for Payment submitted by the Contractor based on any of the reasons set forth in Section 9.5.1 of the General Conditions.
In witness whereof, the parties hereto have executed this Agreement, the Day and Year first above written:

Contractor

By: 
  Signature 
  Printed name and title 

SEAL 

Attest:

The Trustees of Indiana University 
Owner 

By: 
  Treasurer

SEAL 

Attest:

, Secretary

Page 3 of 3
ESCROW AGREEMENT

THIS ESCROW AGREEMENT entered into this ____ day of _______ 20__ between THE TRUSTEES OF INDIANA UNIVERSITY, (herein called “Owner”), and _______________ (herein called “Contractor”), and FIRST FINANCIAL BANK as Escrow Agent (herein called “Escrow Agent”), WITNESSETH:

WHEREAS, Owner contracted with Contractor on ________________, to provide for the construction of a public building, work or improvement subject to the provisions of 5-16-5.5 of the Indiana Code; and

WHEREAS, the contract provides that portions of payments by Owner to the Contractor shall be retained by Owner (herein called Retainage) and placed in an escrow account.

NOW, THEREFORE, it is agreed as follows:

1. Owner will deliver to Escrow Agent the Retainage, to be held in escrow in accordance with the terms of this Agreement.

2. The Escrow Agent shall promptly invest these funds in Treasury Bills, Money Market Funds restricted to direct government obligations, Certificates of Deposit or Savings Accounts to obtain the best interest rate consistent with safety of principal and availability of funds.

3. The Escrow Agent shall hold the escrowed principal until receipt of written authorization from Owner specifying the portion of the escrowed funds to be released to the Contractor. The Escrow Agent shall remit the designated portion of escrowed principal as directed in the notice.

4. Income shall be accrued until termination.

5. If there is a controversy, the Escrow Agent shall pay over the net sum held by it as follows:

   (a) Payment to Owner  In absence of a written authorization from Contractor upon receipt from the Owner of a copy of the Architect’s certificate to Article 14 or Article 46 of the General Conditions showing that the Owner has terminated the employment of the Contractor, the Escrow Agent shall pay over to the Owner the net sum held by it.

   (b) Payment by Court Order  In the absence of joint written authorization and in the absence of the termination of the Contractors provided in (a) above, Escrow Agent will make distribution in the manner directed by a certified copy of a judgment of a Court of Record establishing the rights of the parties to the funds.
6. This Agreement and anything done or performed by either the Contractor or Owner shall not be construed to prejudice or limit the claims which either party may have against the other arising out of the contract.

7. The duties and responsibilities of the Escrow Agent shall be limited to those expressly set forth, to hold the money and to pay and deliver to the person and under the conditions as set forth. Escrow Agent shall act in good faith using its best judgment. Escrow Agent shall not be liable for any act taken or omitted in good faith and shall be fully protected when relying on any written notice, demand, certificate or document which it believes to be genuine.

8. The Escrow Agent shall be and hereby is, indemnified and saved harmless by the Contractor from all losses, liabilities, costs and expenses, including attorney fees and expenses, which may be incurred by it as a result of its acceptance of the Escrow Account or arising from the performance of its duties hereunder, unless such losses, liabilities, costs and expenses shall have been finally adjudicated to have resulted from the bad faith or negligence of the Escrow Agent, and such indemnification shall survive its resignation or removal, or the termination of this Agreement. In no event shall the Escrow Agent be liable for special or consequential damages.

9. The Escrow Agent may resign as such following the giving of thirty (30) days prior written notice to the other parties hereto.

**CONTRACTOR:**

**OWNER:**

Trustees of Indiana University
1800 N. Range Road
Bloomington, IN 47408

BY: ____________________________  BY: ____________________________

Mary Frances McCourt
Treasurer

**ESCROW AGENT:**

**FIRST FINANCIAL BANK**

BY: ____________________________

Authorized Officer

Address:
First Financial Bank
300 West Sixth Street
Bloomington, IN 47404
Ph: 812.330.1280
Fax: 812.330.1310
Contact: Scott Trilling (812.337.2125)
ESCROW AGREEMENT

THIS ESCROW AGREEMENT entered into this ____ day of ________________ between
THE TRUSTEES OF INDIANA UNIVERSITY, (herein called "Owner"), and
__________________________________ of Indianapolis, Indiana, CONTRACTOR (herein
called "Contractor"), and THE BANK OF NEW YORK MELLON TRUST COMPANY,
N.A., as Escrow Agent (herein called "Escrow Agent"), WITNESSETH:

WHEREAS, Owner contracted with Contractor on ______________________
to provide for the construction of a public building, work or improvement subject to the provisions of 5-16-5.5 of the Indiana Code; and

WHEREAS, the contract provides that portions of payments by Owner to the Contractor shall be retained by Owner (herein called Retainage) and placed in an escrow account.

NOW, THEREFORE, it is agreed as follows:

1. Owner will deliver to Escrow Agent the Retainage, to be held in escrow in accordance with the terms of this Agreement.

2. The Escrow Agent shall, at the written direction of the Owner, promptly invest these funds in Treasury Bills, Money Market Funds restricted to direct government obligations, Certificates of Deposit or Savings Accounts to obtain the best interest rate consistent with safety of principal and availability of funds.

3. The Escrow Agent shall hold the escrowed principal until receipt of written authorization from Owner specifying the portion of the escrowed funds to be released to the Contractor. The Escrow Agent shall remit the designated portion of escrowed principal as directed in the notice.

4. Income shall be accrued until termination. The Escrow Agent shall deduct, before any payment from the income received hereunder, its fee as Escrow Agent, which fee shall be in accordance with the fee schedule attached in Exhibit A.

5. If there is a controversy, the Escrow Agent shall pay over the net sum held by it as follows:

(a) Payment to Owner In absence of a written authorization from Contractor upon receipt from the Owner of a copy of the Architect’s certificate to Article 14 or Article 46 of the General Conditions showing that the Owner has terminated the employment of the Contractor, the Escrow Agent shall pay over to the Owner the net sum held by it.

(b) Payment by Court Order In the absence of joint written authorization and in the absence of the termination of the Contractors provided in (a) above, Escrow Agent will make distribution in the manner directed by a certified copy of a judgment of a court of competent jurisdiction establishing the rights of the parties to the funds.
6. This Agreement and anything done or performed by either the Contractor or Owner shall not be construed to prejudice or limit the claims which either party may have against the other arising out of the contract.

7. The duties and responsibilities of the Escrow Agent shall be limited to those expressly set forth, to hold the money and to pay and deliver to the person and under the conditions as set forth. Escrow Agent shall act in good faith and without negligence using its best judgment. Escrow Agent shall not be liable for any act taken or omitted in good faith and without negligence and shall be fully protected when relying on any written notice, demand, certificate or document which it believes to be genuine. The Escrow Agent shall have the right to consult with counsel and shall not be liable for action taken or omitted to be taken in good faith and without negligence by the Escrow Agent.

8. The Escrow Agent shall be and hereby is, indemnified and saved harmless by the Contractor from all losses, liabilities, costs and expenses, including attorney fees and expenses, which may be incurred by it as a result of its acceptance of the Escrow Account or arising from the performance of its duties hereunder, unless such losses, liabilities, costs and expenses shall have been finally adjudicated to have resulted from the bad faith or negligence of the Escrow Agent, and such indemnification shall survive its resignation or removal, or the termination of this Agreement. In no event shall the Escrow Agent be liable for special or consequential damages, nor shall the Escrow Agent have an obligation to use or risk its own funds.

9. The Escrow Agent may resign as such following the giving of thirty (30) days prior written notice to the other parties hereto. On or before the end of the 30 days, the Escrow Agent shall deposit the escrow fund with a successor escrow agent appointed by the Owner or by depositing the escrow fund with the Owner.

CONTRACTOR:

________________________

________________________

________________________

BY: _________________________

OWNER:

The Trustees of Indiana University
1800 N. Range Road
Bloomington, IN 47408

BY: _________________________

MaryFrances McCourt
Treasurer

ESCROW AGENT:

The Bank of New York Mellon Trust Company, N.A.,
300 N. Meridian Street, Suite 910
Indianapolis, IN 46204-0152

BY: _________________________

Authorized Officer
Exhibit A

Indiana University Retainage Escrow
Fee Schedule

Upon appointment of BNYM as escrow agent, the Contractor shall be responsible for the payment of the fees, expenses and charges as set forth in this Fee Schedule.

ACCEPTANCE FEE: WAIVED

ANNUAL ADMINISTRATION FEE: $450.00
Our annual administration fee is a flat fee billed annually in arrears. If the term of the escrow is less than one full year, a minimum fee of $450.00 will be charged for the first year. If the term is greater than one year, the fee for additional partial years will be prorated based on the number of months open during the year. The Escrow Agent shall deduct the fee from the balance in the Escrow Account.

- The annual administration fee includes the below listed items, as applicable.
  - Initial Account Set-up
  - Routine Escrow Administration
  - Statements of Account to Owner and Contractor
  - Asset Principal & Income Collection
  - Processing of Cash Receipts and Disbursements

INVESTMENT COMPENSATION
With respect to investments in money market mutual funds for which BNYM provides shareholder services BNYM (or its affiliates) may also receive and retain additional fees from the mutual funds (or their affiliates) for shareholder services as set forth in the Authorization and Direction to BNYM to Invest Cash Balances in Money Market Mutual Funds.

MISCELLANEOUS FEES
The fees for performing extraordinary or other services not contemplated at the time of the execution of the transaction or not specifically covered elsewhere in this schedule will be commensurate with the service to be provided and may be charged in BNYM’s sole discretion. These extraordinary services may include, but are not limited to, supplemental agreements, unusual releases and the preparation of special or interim reports. The fee for non-interest bearing balances left uninvested with the Bank will be 10 basis points for the quarter, based on quarter-end spot balance levels, in excess of $1,000,000 (held in the U.S. offices of the Bank). Counsel, accountants, special agents and others will be charged at the actual amount of fees and expenses billed.

OUT-OF-POCKET EXPENSES At Cost
Additional out-of-pocket expenses may include, but are not limited to, telephone; facsimile; courier; copying; postage; supplies; statutory filing charges, and expenses of BNYM’s representative(s) and Counsel for attending special meetings. Fees and expenses of BNYM’s representatives and Counsel will be charged at the actual amount of fees and expenses charged and all other expenses will be charged at cost.
TERMS OF PROPOSAL

Final acceptance of the appointment as escrow agent under the Escrow Agreement is subject to approval of authorized officers of BNYM and full review and execution of all documentation related hereto. Please note that if this transaction does not close, you will be responsible for paying any expenses incurred, including Counsel fees. We reserve the right to terminate this offer if we do not enter into final written documents within three months from the date this document is first transmitted to you. Fees may be subject to adjustment during the life of the engagement.

MISCELLANEOUS

The terms of this Fee Schedule shall govern the matters set forth herein and shall not be superseded or modified by the terms of the Escrow Agreement. This Fee Schedule shall be governed by the laws of the State of Indiana without reference to laws governing conflicts. BNYM and the undersigned agree to jurisdiction of the federal and state courts located in the City of Indianapolis, State of Indiana.

CUSTOMER NOTICE REQUIRED BY THE USA PATRIOT ACT

To help the US government fight the funding of terrorism and money laundering activities, US Federal law requires all financial institutions to obtain, verify, and record information that identifies each person (whether an individual or organization) for which a relationship is established.

What this means to you: When you establish a relationship with BNYM, we will ask you to provide certain information (and documents) that will help us to identify you. We will ask for your organization’s name, physical address, tax identification or other government registration number and other information that will help us to identify you. We may also ask for a Certificate of Incorporation or similar document or other pertinent identifying documentation for your type of organization.

We thank you for your assistance.

Accepted By:

Owner: The Trustees of Indiana University

Signature: ____________________________
Date: _____________________________
Name: ____________________________
Title: _____________________________

Escrow Agent: BNYMTC, N.A.

Signature: ____________________________
Date: _____________________________
Name: Daryl F. Mergenthal
Title: Authorized Officer

Contractor: ____________________________

Signature: ____________________________
Date: _____________________________
Name: ____________________________
Title: _____________________________

General Conditions of the Contract for Construction,
Construction Manager as Adviser Edition

for the following PROJECT:
(Name, and location or address)

«THE TRUSTEES OF INDIANA UNIVERSITY»

THE CONSTRUCTION MANAGER:
(Name, legal status and address)

THE OWNER:
(Name, legal status and address)

THE ARCHITECT:
(Name, legal status and address)

ADDITIONS AND DELETIONS:
The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An Additions and Deletions Report that notes added information as well as revisions to the standard form text is available from the author and should be reviewed.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

This document is intended to be used in conjunction with AIA Documents A132™–2009, Standard Form of Agreement Between Owner and Contractor, Construction Manager as Adviser Edition; B132™–2009, Standard Form of Agreement Between Owner and Architect, Construction Manager as Adviser Edition; and C132™–2009, Standard Form of Agreement Between Owner and Construction Manager as Adviser.

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ARTICLE 1  GENERAL PROVISIONS

§ 1.1 Basic Definitions

§ 1.1.1 The Contract Documents. The Contract Documents consist of these General Conditions of the Contract for Construction Between Owner and Contractor, Supplementary General Conditions Indiana University Project Site Requirements, Notice to Bidders, Instructions to Bidders, Bid Forms, Notice to Proceed, Drawings, Specifications, Construction Agreement, Addenda issued prior to execution of the Construction Agreement, any other documents listed in the Agreement, approved Schedules (per §3.10.4), and Modifications issued after execution of the Construction Agreement. A Modification is (1) a written amendment to the Contract signed by both parties, (2) a Construction Change Directive or (3) a written order for a minor change in the Work issued by the Owner’s Representative.

§ 1.1.2 The Contract. The Contract Documents form the Contract for Construction. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations or agreements, either written or oral. The Contract may be amended or modified only by a Modification. The Contract Documents shall not be construed to create a contractual relationship of any kind (1) between the Contractor and the Owner’s Representative or the Owner’s Representative’s consultants, (2) between the Owner and the Construction Manager or the Construction Manager’s consultants, (3) between the Owner and the Owner’s Representative or the Owner’s Representative’s consultants, (4) between the Contractor and the Construction Manager or the Construction Manager’s consultants, (5) between the Owner and a Subcontractor or Sub-subcontractor (6) between the Construction Manager and the Owner’s Representative, or (7) between any persons or entities other than the Owner and Contractor. The Construction Manager and Owner’s Representative shall, however, be entitled to performance and enforcement of obligations under the Contract intended to facilitate performance of their duties.

§ 1.1.3 The Work. The term “Work” means the construction and services required by the Contract Documents, whether completed or partially completed, and includes all other labor, materials, equipment and services provided or to be provided by the Contractor to fulfill the Contractor’s obligations. The Work also includes labor, materials and equipment necessary or identical to those tasks or activities which are not specifically described in, but are reasonably inferable from, the Drawings and Specifications. The Work may constitute the whole or a part of the Project.

§ 1.1.4 The Project. The Project is the total construction of which the Work performed under the Contract Documents may be the whole or a part and which may include construction by Prime Contractors and by the Owner’s own forces, including persons or entities under separate contracts not administered by the Construction Manager.

§ 1.1.5 The Drawings. The Drawings are the graphic and pictorial portions of the Contract Documents showing the design, location and dimensions of the Work, generally including plans, elevations, sections, details, schedules and diagrams.

§ 1.1.6 The Specifications. The Specifications are that portion of the Contract Documents consisting of the written requirements for materials, equipment, systems, standards and workmanship for the Work, and performance of related services.

§ 1.1.7 Instruments of Service. Instruments of Service are representations, in any medium of expression now known or later developed, of the tangible and intangible creative work performed by the Owner’s Representative and the Owner’s Representative’s consultants under their respective professional services agreements. Instruments of Service may include, without limitation, studies, surveys, models, sketches, drawings, specifications, and other similar materials.

§ 1.2 Correlation and Intent of the Contract Documents

§ 1.2.1 The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complementary, and what is required by one shall be as binding as if required by all; performance by the Contractor shall be required only to the extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the indicated results. In the event of conflicts or inconsistencies within or among parts of the Contract Documents and applicable standards, codes, and ordinances, the provision granting the Owner the greater rights shall prevail and the Contractor shall either (i) provide the better quality or greater quantity of work or (ii) shall comply with the more stringent requirements; or both in accordance with the Owner’s Representative’s interpretation. Contractor’s obligations in this regard shall in no way diminish the Contractor’s obligations imposed by §3.2 or §3.7.
§ 1.2.2 Organization of the Specifications into divisions, sections and articles, and arrangement of Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade.

§ 1.2.3 Unless otherwise stated in the Contract Documents, words that have well-known technical or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings.

§ 1.2.4 On the Drawings, given dimensions shall take precedence over scaled measurements, large scale drawings over small scale drawings, and drawings of a later date over drawings of an earlier date. Unless expressly authorized, drawings shall not be scaled for dimensions. If figured dimensions are not given on the Drawings, the Contractor shall timely request the same from the Owner’s Representative.

§ 1.2.5 When references to laws, codes, regulations or standards of technical associations or organizations are included in the Contract Documents, the most current edition is intended and shall govern unless otherwise specified.

§ 1.2.6 Whenever a product is specified by proprietary designations, model numbers, catalog numbers, manufacturer trade names, or similar references, no substitution may be made unless it is accepted in writing by the Owner’s Representative.

§ 1.2.7 The layout of mechanical and electrical systems, equipment, fixtures, piping, ductwork, conduit, specialty items, accessories shown on the Drawings in diagrammatic, and all variations in alignment, elevation and details required to avoid interferences and satisfy all architectural and structural limitations are not necessarily shown. Actual layout of the Work shall be carried out without affecting the architectural or structural integrity and limitations of the Work and shall be performed in such sequence and manner as to avoid conflicts, provide clear access to all control points, including valves, strainers, control devices and specialty items of every nature related to such systems and equipment, obtain maximum headroom, and provide clearances as required for operation and maintenance.

§ 1.2.8 A typical or representative detail on the Drawings shall constitute the standard for workmanship and material throughout corresponding parts of the Work. Where necessary, and where reasonably inferable from the Contract Documents, the Contractor shall adapt such representative detail for application to the Work subject to the prior approval of the Owner’s Representative.

§ 1.3 Capitalization
Terms capitalized in these General Conditions include those that are (1) specifically defined, (2) the titles of numbered articles or (3) the titles of other documents published by the American Institute of Architects.

§ 1.4 Interpretation
In the interest of brevity the Contract Documents frequently omit modifying words such as “all” and “any” and articles such as “the” and “an,” but the fact that a modifier or an article is absent from one statement and appears in another is not intended to affect the interpretation of either statement.

§ 1.5 Ownership and Use of Drawings, Specifications and Other Instruments of Service
§ 1.5.1 The Owner’s Representative and the Owner Representative’s consultants shall be deemed the authors of their respective Instruments of Service, including the Drawings and Specifications. Pursuant to the contract between the Owner’s Representative and the Owner, the Owner holds all right, title and interest, including copyright, and will retain all common law, statutory and other reserved rights, including copyrights. The Contractor, Subcontractors, sub-subcontractors, and material or equipment suppliers shall not own or claim a copyright in the Instruments of Service. Submittal or distribution to meet official regulatory requirements or for other purposes in connection with this Project is not to be construed as publication in derogation of the Owner’s, or Owner’s Representative’s reserved rights or that of the Owner’s Representative or its consultants.

§ 1.5.2 The Contractor, Subcontractors, Sub-subcontractors, and material or equipment suppliers are authorized to use and reproduce the Instruments of Service provided to them solely and exclusively for execution of the Work. All copies made under this authorization shall bear the copyright notice, if any, shown on the Instruments of Service. The Contractor, Subcontractors, Sub-subcontractors, and material or equipment suppliers may not use the
Instruments of Service on other projects or for additions to this Project outside the scope of the Work without the specific written consent of the Owner, the Owner’s Representative or the Owner’s Representative’s consultants.

§ 1.6 Transmission of Data in Digital Form
If the parties intend to transmit Instruments of Service or any other information or documentation in digital form, they shall endeavor to establish necessary protocols governing such transmissions, unless otherwise already provided in the Agreement or the Contract Documents.

ARTICLE 2 OWNER
§ 2.1 General
§ 2.1.1 The Owner is The Trustees of Indiana University and is referred to throughout the Contract Documents as singular in number. The term “Owner’s Representative” shall refer to the Owner’s Representative, Engineer or other licensed design professional hired by the Owner for this Project and shall have express authority to bind the Owner with respect to all matters requiring the Owner’s approval or authorization unless and until such authority is modified or a new representative is identified in writing by the Owner. Except as otherwise provided in Article 4, the Construction Manager and the Owner’s Representative do not have such authority. The term “Owner” means the Owner or the Owner’s authorized representative.

§ 2.2 Information and Services Required of the Owner
§ 2.2.1 Except for permits and fees that are the responsibility of the Contractor under the Contract Documents, including those required under Section 3.7.1, the Owner shall secure and pay for necessary approvals, easements, assessments and charges required for construction, use or occupancy of permanent structures or for permanent changes in existing facilities.

§ 2.2.2 The Owner shall furnish surveys describing physical characteristics, legal limitations and utility locations for the site of the Project, and a legal description of the site. Subject to the limitations and qualifications of the Contract Documents, including but not limited to Section 3.1.4, the Contractor may reasonably rely on the accuracy of the information furnished by the Owner but shall exercise proper precautions relating to the safe performance of the Work.

§ 2.2.3 The Owner shall furnish information or services required of the Owner by the Contract Documents with reasonable promptness. The Owner shall also furnish any other information or services under the Owner’s control and relevant to the Contractor’s performance of the Work with reasonable promptness after receiving the Contractor’s written request for such information or services.

§ 2.2.4 Unless otherwise provided in the Contract Documents, the Owner shall furnish to the Contractor one copy of the Contract Documents for purposes of making reproductions pursuant to Section 1.5.2.

§ 2.2.5 The Owner shall endeavor to forward all communications to the Contractor through the Construction Manager and shall contemporaneously provide the same communications to the Owner’s Representative about matters arising out of or relating to the Contract Documents.

§ 2.3 Owner’s Right to Stop the Work
If the Contractor fails to correct Work that is not in accordance with the requirements of the Contract Documents as required by Section 12, persistently fails to carry out the Work in accordance with the Contract Documents, or fails to clean up as required by Section 3.15 and Supplementary Conditions Paragraph 10, the Owner may issue a written order to the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated. However, the right of the Owner to stop the Work shall not give rise to a duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity. The stoppage of Work pursuant to this Section 2.3 shall not entitle the Contractor to an adjustment of the Contract Sum, the Contract Time or the Contract Schedule.

§ 2.4 Owner’s Right to Carry Out the Work
If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a ten-day period after receipt of written notice from the Owner to commence and continue correction of such default or neglect with diligence and promptness, the Owner may, without prejudice to other remedies the Owner may have, correct such deficiencies. In such case an appropriate Construction Change Directive shall be issued deducting from payments then or thereafter due the Contractor the reasonable cost of correcting such deficiencies, including Owner’s expenses and compensation for the Construction Manager’s and Owner Representative’s and
Owner Representative consultants’ additional services made necessary by such default, neglect or failure. Such action by the Owner and amounts charged to the Contractor are both subject to prior approval of the Owner’s Representative, after consultation with the Construction Manager. If payments then or thereafter due the Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner.

§ 2.5 OWNER’S RIGHT TO REJECT DEFECTIVE WORK
The Owner shall have the right, but not the duty, to approve all materials and workmanship incorporated, or to be incorporated, into the Work and may reject as defective any work that is not, in the judgment of the Owner and the Owner’s Representative, in strict accordance with the requirements of the Contract Documents. Work so rejected shall be promptly removed and corrected by the Contractor. No Work which the Owner expressed its intention to inspect shall be closed or covered by the Contractor until it has been duly inspected and approved by the Owner. Should the Contractor close or cover uninspected Work then the Contractor shall, at its own cost and expense, uncover all such Work so that it may be inspected. After Owner’s inspection is complete, Contractor shall then properly repair or replace all affected Work.

§ 2.6 OWNER’S CONFIDENTIAL INFORMATION
The Owner may designate to Contractor such information or documents that Owner wishes to be kept confidential in connection with the Work or the Project. Such designation shall be in writing. Information designated by the Owner as “Confidential” shall not be disclosed, communicated or transmitted to any person or entity other than Contractor’s employees, agents or subcontractors as may be necessary for the performance of the Work. Contractor shall require its subcontractors, vendors, material suppliers and the like to comply with this requirement. Documents designated as “Confidential” (and all copies thereof) shall be immediately returned to the Owner upon request. The requirements of this Section 2.6 shall survive Owner’s final acceptance of the Work or earlier termination of the Contract.

ARTICLE 3 CONTRACTOR
§ 3.1 General
§ 3.1.1 The Contractor is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. If the Work of the Project has been divided into the following parts, each part will be performed by the separate Prime Contractor indicated below:

.1 General construction work, by the General Contractor;

.2 Mechanical construction work, by the Mechanical Contractor; and

.3 Electrical construction work, by the Electrical Contractor.

§ 3.1.2
.1 In the Instructions to Bidders, Bid Form, General Conditions, Supplementary Conditions, all sections of Division 1 of the Specifications, and in all addenda and modifications to the Contract Documents, the term ‘Contractor’ means each of them, unless specific reference is made to a particular Prime Contractor.

.2 In the Agreement for General Construction Work, the site development drawings, the architectural drawings, and all sections of the Specifications, the term ‘Contractor’ means the General Contractor, unless specific reference is made to another Prime Contractor.

.3 In the Agreement for Mechanical Construction Work, the mechanical drawings, and all sections of Division 23 of the Specifications, the term ‘Contractor’ means the Mechanical Contractor, unless specific reference is made to another Prime Contractor.

.4 In the Agreement for Electrical Construction Work, the electrical drawings, and in all sections of Division 26 of the Specifications, the term ‘Contractor’ means the Electrical Contractor, unless reference is made to another Prime Contractor.
In any other Agreement with any other Prime Contractor for that Prime Contractor’s scope of work, and any drawings and/or specifications related thereto, the term ‘Contractor’ shall mean that specific Prime Contractor, unless specific reference is made to another Prime Contractor.

All references in the Contract Documents to ‘Contractor’ and/or to third parties under contract or control of the Contractor shall be deemed to be reference to the Contractor. The relationship between the Owner and the Contractor is that of independent contractor. The Contract Documents shall not be construed to make the Contractor the agent, servant or employee of the Owner or to create any joint venture, partnership or other association between the Owner other than that of independent contractor.

§ 3.1.3 The plural term “Prime Contractors” refers to persons or entities who perform construction under contracts with the Owner that are administered by the Construction Manager. The term includes General Contractor but does not include the Owner’s own forces, including persons or entities under separate contracts not administered by the Construction Manager.

§ 3.1.4 The Contractor shall perform the Work in accordance with the Contract Documents.

§ 3.1.5 The Contractor shall not be relieved of obligations to perform the Work in accordance with the Contract Documents either by activities or duties of the Construction Manager or Owner’s Representative in their administration of the Contract, or by tests, inspections or approvals required or performed by persons or entities other than the Contractor.

§ 3.1.6 No later than thirteen (13) calendar days after the date of the Notice to Proceed, the Contractor shall deliver to the Owner certified as true and accurate and with no material changes as of the date of delivery: (i) Contractor’s required payment and performance bond; (ii) all required Certificates of Insurance, including a Certificate of Compliance for worker’s compensation insurance or, if applicable, a Worker’s Compensation Exemption Certificate Clearance.

3.1.7 Contractor shall expeditiously execute the Construction Agreement with the Owner and shall, along with the executed Construction Agreement, provide the Owner with its executed Escrow Agreement, as contemplated in Section 1 of the Supplementary Conditions, and with its Corporate Authority Signature Certificate and W9, as required by the Instructions to Bidders.

§ 3.2 Review of Contract Documents and Field Conditions by Contractor

§ 3.2.1 By executing the Contract, the Contractor represents to the Owner that: (1) the Contractor has a high level of experience and expertise in the business administration construction, management, workplace health and safety supervision and superintendence of projects of similar size and complexity and that it will perform the Work with the care, skill and diligence of such a contractor; (2) Contractor and, to the best of its knowledge, its subcontractors are financially solvent, able to pay all debts as they mature and have sufficient working capital to complete the Work and all obligations thereunder; (3) Contractor is able to furnish the plant, tools, materials, supplies, equipment and labor required to complete the Work; (4) Contractor is authorized to do business in the State of Indiana; (5) Contractor’s execution of the Contract and its performance thereof are within its authorized powers; (6) Contractor has (i) studied the Contract Documents, understands their provisions and confirmed that they are sufficiently detailed and complete to permit the Contractor to perform the Work in accordance with the Contract Documents, within the Contract Time and for the Contract Sum; (ii) inspected the Project site; and (iii) investigated and satisfied itself as to: (a) the site and locality where the Work is to be performed and the conditions and difficulties to be encountered, including access thereto; (b) in accordance with the provisions of the Instructions to Bidders Article 5 and Supplementary Conditions Section 2, the type and condition of the soil including the quality and quantity of the subsurface and surface materials or obstacles to be encountered; (c) the availability of utilities and access thereto; (d) conditions affecting transportation, disposal, handling and storage of materials, supplies and equipment; (e) any materials, supplies or equipment which are to be furnished by the Owner for the Contractor’s use; (f) the type and availability of tools, equipment and facilities to perform the Work; (g) the availability and adequacy of labor and trades, local common construction wage scales and, if applicable, union wage scales, benefits, working conditions, craft jurisdictions, area practices and collective bargaining agreements affecting the Work; (h) prevailing weather and climatological conditions; (i) all laws applicable to the Work and to the Contractor; and (j) all other factors which may affect the Contractor’s performance of the Work.
§ 3.2.2 Contractor has executed the Contract based on its own examination, investigation and evaluation of the matters set forth in Section 3.2.1 above and not in reliance on any representation of the Owner, Owner’s Representative or any of their respective employees or agents which is not expressly set forth in the Contract Documents. No failure by the Contractor to consider or evaluate such matters shall relieve the Contractor from its responsibility to properly estimate the difficulty, cost and expense of performing the Work. Contractor shall not be entitled to, and Owner shall not be liable for, an adjustment to the Contract Sum, Contract Time or Contract Schedule which results directly or indirectly from Contractor’s failure to properly examine, investigate or evaluate the matters set forth in Section 3.2.1.

§ 3.2.2.1 Because the Contract Documents are complementary, the Contractor shall, before starting any portion of the Work, carefully study and compare the various Drawings and other Contract Documents relative to that portion of the Work, as well as the information furnished by the Owner pursuant to Section 2.2, shall take field measurements of any existing conditions related to that portion of the Work, and shall observe any conditions at the site affecting it. These obligations are for the purpose of facilitating construction by the Contractor and are not for the purpose of discovering errors, omissions, or inconsistencies in the Contract Documents; however, any errors, inconsistencies or omissions discovered by the Contractor shall be reported promptly to the Owner’s Representative as a request for information in such form as the Owner’s Representative may require.

§ 3.2.2.2 The exactness of grades, elevations, dimensions or locations shown on Drawings issued by the Owner’s Representative or Work installed by other Contractors is not guaranteed by the Owner’s Representative or the Owner. Consequently, prior to ordering any materials or performing any work, Contractor shall satisfy itself as to the accuracy of all grades, elevations, dimensions, and locations and in all cases of interconnection of its Work with existing or other Work, shall verify, at the site, all dimensions relating to such existing or other Work. If a minor change in the Work is necessary because of actual field conditions, the Contractor shall submit detailed drawings of such change to the Owner’s Representative for approval before making the change. Any significant dimensional differences shall be submitted to the Owner’s Representative before proceeding with the Work. Any errors resulting from Contractor’s failure to so verify shall be promptly rectified by Contractor at no additional cost to the Owner. No increase in the Contract Sum or the Contract Time shall be allowed because of differences between actual dimensions and dimensions on the Drawings.

§ 3.2.3 Any design errors or omissions discovered by the Contractor during the exercise of its obligations pursuant to this Section 3.2 shall be reported promptly to the Owner’s Representative in writing. The Contractor’s review is made in its capacity as a contractor and not as a licensed design professional unless otherwise specifically provided in the Contract Documents.

§ 3.2.4 If the Contractor believes that additional cost or time is involved because of clarifications or instructions the Owner’s Representative issues in response to the Contractor’s notices or requests for information pursuant to Sections 3.2.2.1 or 3.2.3, the Contractor shall make Claims as provided in Article 15. If the Contractor fails to perform its obligations pursuant to this Section 3.2, the Contractor shall pay such costs and damages to the Owner as would have been avoided or mitigated if the Contractor had performed such obligations. If the Contractor performs those obligations, the Contractor shall not be liable to the Owner or Owner’s Representative for damages resulting from errors, inconsistencies or omissions in the Contract Documents, for differences between field measurements or conditions and the Contract Documents, or for nonconformities of the Contract Documents to applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities.

§ 3.2.5 Except for errors, omissions, or inconsistencies reported by the Contractor, and concealed or unknown conditions in Section 3.7.4, by executing the Agreement, Contractor represents that:

.1 The Contract Documents are sufficiently complete and detailed for Contractor to perform the Work required and to produce the results indicated by the Contract Documents; and

.2 The Work as specified in the Contract Documents, including without limitation, use of materials, selection of equipment, requirements of product, manufacturers and Contractor’s means, methods, procedures and techniques utilized to perform the Work are consistent with (i) good and proper practices within the construction industry, (ii) generally accepted or prevailing laws, regulations, ordinances and/or industry standards applicable to the Work, and (iii) the requirement of any warranties applicable to the Work.
§ 3.3 Supervision and Construction Procedures

§ 3.3.1 The Contractor shall supervise and direct the Work, using the Contractor’s best skill and attention. The Contractor shall be solely responsible for, and have control over, construction means, methods, techniques, sequences and procedures and for coordinating all portions of the Work under the Contract, unless the Contract Documents give other specific instruction concerning these matters. If the Contract Documents give specific instructions concerning construction means, methods, techniques, sequences or procedures, the Contractor shall evaluate the jobsite safety thereof and, except as stated below, shall be fully and solely responsible for the jobsite safety of such means, methods, techniques, sequences or procedures. If the Contractor determines that such means, methods, techniques, sequences or procedures may not be safe, the Contractor shall give timely written notice to the Owner, the Construction Manager, and the Owner’s Representative and shall not proceed with that portion of the Work without further written instructions from the Owner’s Representative, through the Construction Manager.

§ 3.3.1.1 The Construction Manager shall be responsible for scheduling, coordinating and expediting the Work. All Prime Contractors shall cooperate with the Construction Manager and comply with the Construction Manager’s directions with respect to scheduling and coordination of their work with the Work as a whole. The Construction Manager shall make monthly reports to the Owner and Owner’s Representative regarding the performance of each Prime Contractor. If a Prime Contractor fails or refuses to comply with its obligations under this Section 3.3.1.1, the Owner’s Representative may withhold certification of its application for payment and such failure or refusal shall constitute a basis for termination for cause.

3.3.1.1.1 The Owner has assigned to the CM the responsibility for coordination of the Work and the certification of applications for payment and each Prime Contractor shall accept this assignment of coordination as a condition of its Contract.

§ 3.3.1.2 The General Contractor shall establish and maintain benchmarks and all other grades, lines and levels necessary for the Work, report errors, omissions or inconsistencies to the Owner and Owner’s Representative before commencing the Work and, if applicable, review the placement of the building(s) and permanent facilities on the site with the Owner and Owner’s Representative after all lines are staked out and before foundation work is started. If a survey reveals any encroachments by the Contractor or its Subcontractors or adjacent properties caused by construction (except for encroachments arising from errors or omissions in the Contract Documents, not reasonably discoverable by the Contractor) such encroachment shall be the sole responsibility of Contractor and Contractor shall correct such encroachment within thirty (30) days after discovery or as soon thereafter as is reasonably possible, at Contractor’s sole cost and expense, either by removal of the encroachment and subsequent reconstruction on the Project Site, or agreement with the Owner if the adjacent property is owned by The Trustees of Indiana University or by agreement with any third party owner in a form and substance satisfactory to Owner.

§ 3.3.2 The Contractor shall be responsible to the Owner for acts and omissions of the Contractor’s employees, Subcontractors and their agents and employees, and other persons performing portions of the Work for, or on behalf of, the Contractor or any of its Subcontractors. Contractor shall remove or cause to be removed from the Project any person or entity for whom Contractor is responsible, that the Owner or Owner’s Representative determines to be detrimental to the Project.

§ 3.3.2.1 Neither Contractor nor its employees, Subcontractors or agents shall engage in sexual harassment in violation of Title VII of the Civil Rights Act of 1964 or discrimination based on sexual orientation in violation of University policy. In addition, Contractor will ensure that Indiana University students, employees and guests are protected from lewd, offensive or harassing conduct by Contractor’s employees, Subcontractors and agents. Additional requirements are set forth in Supplemental Conditions, Section 8.

§ 3.3.3 The Contractor shall be responsible for inspection of portions of the Project already performed to determine that such portions are in proper condition to receive subsequent Work.

§ 3.4 Labor and Materials

§ 3.4.1 Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for proper execution and completion of the Work, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work. In the event that any Subcontractor, supplier, design professional or other entity for whom the Contractor is responsible asserts a verified claim, bond claim, mechanic’s lien, if applicable, or other payment claim against the Owner and/or the Project, the Contractor shall
promptly resolve said claim and shall defend, indemnify and hold harmless the Owner from all losses, damages or costs incurred in connection therewith, except to the extent the claim arises as a result of the Owner’s failure to timely make payments to the Contractor under the terms of this Agreement. Should the Contractor fail to promptly resolve and/or bond over any such claim or lien, the Contractor shall pay the attorneys’ fees reasonably incurred by the Owner in connection with said claim or lien.

§ 3.4.2 Except in the case of minor changes in the Work authorized by the Owner’s Representative in accordance with Sections 3.12.8 or 7.3, the Contractor may make substitutions only with the consent of the Owner, after evaluation by the Owner’s Representative, in consultation with the Construction Manager, and in accordance with a Construction Change Directive.

§ 3.4.2.1 The Contractor has based the Contract Price on the exact materials specified in the Contract Documents. The Contract Price is not contingent upon the approval of any substitute or “equal” product, material or method. If the Contractor proposes, in writing, an alternate product, material, equipment or method then:

.1 The product, material or method called for in the Contract Documents is intended to establish the standard of quality and design; however, an ‘equal’ product, material, equipment or method may be used if approved in writing as “equal” by the Owner’s Representative.

.2 The terms “or approved equal” is deemed to be included after all products, materials, equipment or methods described in the Contract Documents.

.3 Proposed substitutions shall be supported by appropriate certifications or other materials necessary to support the proposed substitution. All costs associated with the evaluation of a proposed substitution (including but not limited to the cost of Additional Services rendered by the Owner’s Representative) shall be borne by the Contractor.

.4 The Owner’s Representative shall be the sole judge of equivalency.

.5 Acceptance of a proposed substitution shall not relieve the Contractor from responsibility for compliance with all the requirements of the Contract Documents. The Contractor shall be completely responsible for it the cost of any changes to other parts of its Work or the work of other Contractors caused by such substitution, including the cost of all necessary design or redesign services.

.6 The Contract Time shall not be extended and the Contract Price shall not be increased as the result of any substitution.

§ 3.4.3 The Contractor shall enforce strict discipline and good order among Contractor’s employees, Subcontractors and other persons or entities carrying out the Work. The Contractor shall employ or contract with only persons or entities fit and skilled in tasks assigned to them. Contractor shall use its best efforts to minimize the likelihood or impact of any strike, work stoppage or other disturbance.

.1 If the Work is to be performed by trade unions, Contractor shall make all necessary arrangements to reconcile, without delay, damage or cost to the Owner and without recourse to the Owner’s Representative or the Owner, any conflict between the requirements of the Contract Documents and any labor agreements or regulation of any kind in force among members of councils that regulate or designate the work or activities of any particular trade or craft.

.2 If the progress of the Work is affected by an undue delay in furnishing or installing an item, material or equipment specified in the Contract Documents because of a conflict involving a labor agreement or regulation, the Owner may require that other material or equipment of equal kind and quality be substituted pursuant to a Construction Change Directive.

§ 3.4.4 Contractor shall not be entitled to any adjustment in the Contract Sum or the Contract Time as the result of work stoppages, slow downs, disputes or strikes which result from or are caused by a wrongful act or unlawful act of Contractor, a Subcontractor or other person or entity for whom Contractor is responsible.
§ 3.4.5 Except in the case of emergency, no substantial field operations shall be performed outside of regular working hours without the prior notifications of and approval by the Owner’s Representative and Owner. Contractor will not be entitled to additional compensation for work performed outside of regular working hours except by the prior written approval of the Owner. Additional compensation for overtime work shall be limited to the direct cost of the premium portion of the overtime.

§ 3.5 Warranty
Contractor warrants to the Owner and Owner’s Representative that materials and equipment furnished under the Contract will be of good quality and new unless otherwise required or permitted by the Contract Documents, that for a period of not less than two years the Work will be free from defects not inherent in the quality required or permitted, and that the Work will conform to the requirements of the Contract Documents. Work not conforming to these requirements, including substitutions not properly approved and authorized, shall be considered defective. Contractor’s warranty excludes remedy for (i) damage or defect caused by abuse; (ii) modification not executed by the Contractor except modifications performed by the Owner pursuant to Section 2.4; and (iii) improper or insufficient maintenance, improper operation or normal wear and tear or usage. If required by the Owner’s Representative, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

§ 3.5.1 At substantial completion, Contractor shall provide all operations and maintenance manuals to Owner and shall assign to Owner any and all manufacturers’ warranties relating to materials and labor used in the Work. Contractor shall perform the Work in such a manner as to preserve all manufacturers’ warranties.

§ 3.5.2 No warranty of Contractor applicable to workmanship, material, product or equipment shall be voided or in any way diminished because a manufacturer, provider, material, product or equipment was specified or required by the Contract Documents.

§ 3.6 Taxes
§ 3.6.1 Unless otherwise provided in the Contract Documents, the Contractor shall pay sales, consumer, use and similar taxes for the Work provided by the Contractor that are legally enacted when bids are received or negotiations concluded, whether or not yet effective or merely scheduled to go into effect.

§ 3.6.2 Indiana Gross Income Tax. In accordance with Indiana Gross Income Tax, as amended, Owner is a withholding agent for the payment of Indiana Gross Income Tax on contracts with Indiana University and is required to withhold the Indiana Gross Income Tax from a Non-Resident Contractor at the current statutory rate, less an annual exemption of $1,000. The term “Non-Resident Contractor” does not include a contractor that is a corporation organized under the laws of a state other than Indiana but that is licensed, qualified and registered with the Indiana Secretary of State to do business in Indiana.

§ 3.6.3 Indiana Gross Retail Tax. Materials and equipment purchased by Owner for incorporation into the Work are not subject to the Indiana Gross Retail Tax (sales tax). A general exemption certificate must be filed with the vendor by Contractor and Owner will furnish the certificate to Contractor upon request.

§ 3.6.4 Federal Excise Tax. Owner is exempt from payment of Federal Excise Tax and will furnish Contractor an exemption certificate upon request.

§ 3.7 Permits, Fees, Notices, and Compliance with Laws
§ 3.7.1 The Contractor shall secure and pay for other required permits, fees, licenses and inspections by government agencies, if any, necessary for proper execution and completion of the Work that are customarily secured after execution of the Contract and legally required at the time bids are received or negotiations concluded. All connection charges, assessments or inspection fees imposed by any governmental agency or utility company are the Contractor’s responsibility and shall be included in the Contract Sum.

§ 3.7.2 The Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities applicable to performance of the Work.

§ 3.7.3 If the Contractor performs Work knowing it to be contrary to applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, the Contractor shall assume appropriate responsibility for such Work and shall bear the costs attributable to correction.
§ 3.7.4 Concealed or Unknown Conditions. Claims for Concealed or Unknown Conditions. If conditions are encountered at the site which are (1) subsurface or otherwise concealed physical conditions which differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual nature, which differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, then notice by the observing party shall be given to the other party promptly before conditions are disturbed and in no event later than 7 days after first observance of the conditions. The Owner’s Representative will promptly investigate such conditions and, if they differ materially and cause an increase or decrease in the Contractor’s cost of, or time required for, performance of any part of the Work, will recommend an equitable adjustment in the Contract Sum or extension of the Contract Time for such number of days as condition prevents Contractor from achieving Substantial Completion within the Contract Time, or both. Any adjustment in the Contract Time shall be in accordance with the provisions of Section 8.3.2. If the Owner’s Representative determines that the conditions at the site are not materially different from those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the Owner’s Representative shall so notify the Owner and Contractor in writing, stating the reasons. Claims by either party in opposition to such determination must be made within 7 days after the Owner’s Representative has given notice of the decision. No adjustment in the Contract Time or Contract Sum shall be permitted for concealed or unknown conditions that do not differ materially from conditions indicated in the Contract Documents, or that reasonably should have been discovered by Contractor’s prior inspections, tests, reviews, and pre-construction activities, or inspections, tests, reviews and pre-construction activities that the Contractor had the opportunity to perform, or should have performed, in connection with the Work.

§ 3.7.5 If, in the course of the Work, the Contractor encounters human remains or recognizes the existence of burial markers, archaeological sites or wetlands not indicated in the Contract Documents, the Contractor shall immediately suspend any operations that would affect them and shall notify the Owner, Construction Manager, and Owner’s Representative. Upon receipt of such notice, the Owner shall promptly take any action necessary to obtain governmental authorization required to resume the operations. The Contractor shall continue to suspend such operations until otherwise instructed by the Owner but shall continue with all other operations that do not affect those remains or features. Requests for adjustments in the Contract Sum and Contract Time arising from the existence of such remains or features may be made as provided in Article 15.

§ 3.8 Allowances

§ 3.8.1 The Contractor shall include in the Contract Sum all allowances stated in the Contract Documents. Items covered by allowances shall be supplied for such amounts and by such persons or entities as the Owner may direct, but the Contractor shall not be required to employ persons or entities to whom the Contractor has reasonable objection.

§ 3.8.2 Unless otherwise provided in the Contract Documents:

.1 Allowances shall cover the cost to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts;

.2 Contractor’s costs for unloading and handling at the site, labor, installation costs, overhead, profit and other expenses contemplated for stated allowance amounts shall be included in the Contract Sum but not in the allowances; and

.3 Whenever costs are more than or less than allowances, the Contract Sum shall be adjusted accordingly by Construction Change Directive. The amount of the Construction Change Directive shall reflect (1) the difference between actual costs and the allowances under Section 3.8.2.1 and (2) changes in Contractor’s costs under Section 3.8.2.2.

§ 3.8.3 Materials and equipment under an allowance shall be selected by the Owner with reasonable promptness.

§ 3.9 Superintendent

§ 3.9.1 The Contractor shall employ a competent superintendent and necessary assistants who shall be in attendance at the Project site during performance of the Work. The superintendent shall represent the Contractor, and communications given to the superintendent shall be as binding as if given to the Contractor.

§ 3.9.2 The Contractor, as soon as practicable after award of the Contract, shall furnish in writing to the Owner and Owner’s Representative through the Construction Manager, the name and qualifications of a proposed superintendent. The Construction Manager may reply within 14 days to the Contractor in writing stating (1) whether
the Owner, the Construction Manager, or the Owner’s Representative has reasonable objection to the proposed superintendent or (2) that any of them require additional time to review. Failure of the Construction Manager to reply within the 14 day period shall constitute notice of no reasonable objection.

§ 3.9.3 Contractor’s superintendent shall be satisfactory to the Construction Manager, Owner’s Representative and the Owner and shall not be changed without the prior written consent of the Owner. Contractor’s superintendent shall remain on site until not be removed from the Project prior to completion of the Punch List work.

§ 3.10 Contractor’s Construction Schedules

§ 3.10.1 Within 13 calendar days of the date of the Notice to Proceed, each Prime Contractor shall prepare and submit for the Owner’s and Owner’s Representative’s information and the Construction Manager’s approval a construction schedule for its portion of the Work (‘Construction Schedule’) which shall incorporate the Work of other Prime Contractors. The Construction Schedule shall not exceed time limits current under the Contract Documents, shall be revised as required by the Contract Documents or at appropriate intervals as required by the conditions of the Work and Project; shall be coordinated with the entire Project to the extent required by the Contract Documents and shall provide for the expeditious and practicable execution of the Work. The Construction Schedule shall be modified only by a Construction Change Directive executed in accordance with Section 7.2. A submitted Construction Schedule not approved by the Construction Manager that exceeds current time limits shall not relieve the Contractor of its obligation to meet those time limits, shall not make the Owner or Owner’s Representative liable for any damages incurred by the Contractor as the result of extended performance or failure to meet time limits set forth in the most recent approved Construction Schedule. Similarly, a Construction Schedule showing completion of the Work prior to the date required by the Contract Documents shall not create any rights to early completion of the Work. Each Prime Contractor shall cooperate with the Construction Manager in scheduling and performing the Contractor’s Work to avoid conflict with, and as to cause no delay in, the work or activities of other Prime Contractors or the construction or operations of the Owner’s own forces.

§ 3.10.1.1 Each Prime Contractor shall cooperate in the Construction Manager’s development of the Construction Schedule by providing information as to the timing and sequencing of its Work and operations to conform to the Construction Manager’s overall Construction Schedule requirements. Each Prime Contractor continuously shall monitor the Construction Schedule so as to be fully familiar with the timing, phasing and sequencing of its Work and other Work on the Project.

§ 3.10.2 Within 13 calendar days of the date of the Notice to Proceed, each Prime Contractor shall prepare a submittal schedule, promptly after and thereafter as necessary to maintain a current submittal schedule, and shall submit the schedule(s) for the Construction Manager’s and Owner’s Representative’s approval. The Construction Manager’s and Owner’s Representative’s approval shall not unreasonably be delayed or withheld. The submittal schedule shall (1) be coordinated with the Contractor’s construction schedule, and (2) allow the Construction Manager and Owner’s Representative reasonable time to review submittals. If the Contractor fails to submit a submittal schedule, the Contractor shall not be entitled to any increase in Contract Sum or extension of Contract Time based on the time required for review of submittals.

§ 3.10.3 The Contractor shall participate with other Contractors, the Construction Manager and Owner in reviewing and coordinating all schedules for incorporation into the Project schedule that is prepared by the Construction Manager. The Contractor shall make revisions to the construction schedule and submittal schedule as deemed necessary by the Construction Manager to conform to the Project schedule.

§ 3.10.4 The Contractor shall perform the Work in general accordance with the most recent schedules submitted to the Owner, Construction Manager and Owner’s Representative and incorporated into the approved Project schedule.

§ 3.10.5 The Construction Schedule shall be a detailed Critical Path Method (CPM) or other form satisfactory to the Owner and Owner’s Representative and shall (i) provide graphic representation of all activities and events that will occur during the performance of the Work; (ii) identify each phase of construction and occupancy; and (iii) show critical Milestone Dates. Upon approval by the Owner, the Construction Schedule shall be deemed a Contract Document. If not approved each Prime Contractor promptly shall revise the Construction Schedule in accordance with the requirements of the Construction Manager and resubmit for approval. The Construction Manager shall monitor the progress of the Work and the Work of the each Prime Contractors for conformance with the Construction Schedule and promptly submit to the Owner and the Owner’s Representative a written progress report of any delays or potential delays. Compliance with the Construction Schedule is a condition precedent to receiving
payment pursuant to Article 9. The Construction Schedule shall be updated to reflect actual conditions or as requested by the Owner or the Owner’s Representative. If any report indicates delays or potential delays, the Construction Manager with the cooperation of affected Prime Contractor(s) shall propose a plan to correct the delay, including overtime and/or additional labor. A progress report shall not constitute an adjustment in the Contract Time, any Milestone Date, or the Contract Sum.

§ 3.10.6 If the Owner determines that (i) the Work has failed to progress or reach the level of completion required by the Contract Documents, and (ii) such failure is the fault of the Contractor, the Owner may, at no cost to the Owner, order the Contractor to take necessary corrective action to expedite the progress of the Work including without limitation (1) additional shifts or overtime; (2) additional manpower, equipment and facilities; and (3) similar measures. If so ordered, such measures shall continue until the Work is in conformance with the requirements of the Contract Documents. Contractor shall not be entitled to an adjustment of the Contract Sum for the cost of such corrective action.

§ 3.10.7 The Owner may order a postponement or rescheduling of any date or time for the performance of any part of the Work that interferes with the operations of other Contractors, use of the Owner’s premises by the Owner, its tenants or invitees. At the Owner’s request, Contractor shall schedule or reschedule any portion of the Work which adversely affects other Contractors.

§ 3.11 Documents and Samples at the Site
Each Prime Contractor shall maintain at the site for the Owner one copy of the Drawings, Specifications, Addenda, Construction Change Directives and other Modifications, in good order and marked currently to indicate field changes and selections made during construction, and one copy of approved Shop Drawings, Product Data, Samples and similar required submittals. These documents shall be available to the Owner’s Representative and delivered to the Construction Manager for submittal to the Owner upon completion of the Work as a record of the Work as constructed.

§ 3.11.1.1 If any portion of the Work is to be joined to existing buildings or facilities and the Owner has furnished the Contractor with “As-Built” Drawings of said existing buildings or facilities in which the Contractor finds errors, omissions or inaccuracies, then Contractor shall, at no additional cost to the Owner, mark the Owner’s “As-Built” Drawings to show the true and actual conditions and locations discovered during performance of the Work.

§ 3.11.2 As to renovation projects or projects which require the Work to be joined to existing buildings or facilities, if the Owner has furnished to the Contractor “As-Built” Drawings with respect to such existing buildings or facilities and Contractor finds such As-Built Drawings to contain errors, then Contractor, at no additional cost to the Owner, shall mark such As-Built Drawings to show true and actual conditions and locations as discovered during the course of the Work.

§ 3.11.3 The Contractor shall keep at the construction site a complete set of full size bluelined prints of the Contract drawings, reproduced at Contractor’s expense. During construction, these prints shall be marked to show all deviations in actual construction from the Contract drawings. The color red shall be used to indicate all additions, and green to indicate all deletions. The drawings shall show the following information, but not be limited thereto: (a) the locations and description of any utility lines and other installations of an kind or description known to exist within the construction area (the location includes dimensions to permanent features); (b) locations and dimensions of any changes within the building or structure, and the accurate location and the dimension of all underground utilities and facilities; (c) correct grade or alignment of roads, structures, and utilities if any changes were made from Contract plans; (d) correct elevations if changes were made in site grading from the Contract plans; (e) changes in details of design or additional information obtained from working drawings specified to be prepared and/or furnished by the Contractor including, but not limited to, fabrication, erection, installation, and placing details, pipe sizes, installation material, dimensions of equipment foundations, etc.; (f) the topography and grades of all drainage installed or effected as part of the Project construction; (g) all changes or modifications from the original design and from the final inspection; and (h) where Contract drawings or specifications allow options, only the option actually used in the construction shall be shown on the As-Built drawings. The option not used shall be deleted. These deviations shall be shown in the same general detail utilized in the Contract drawings. Marking of the prints shall be pursued continuously during construction to keep them up-to-date. This information shall be maintained in a current condition at all times until the completion of the Work. The resulting field marked data shall be referred to and marked as "As Built Field Data" and shall be used for no other purpose. They shall be made available for inspection by the Owner's representative whenever requested during construction and shall be jointly inspected for accuracy.
and completeness by the Owner’s representative and responsible representative of the Contractor prior to submission of each monthly pay application. Failure to keep the As Built Field Data (including equipment and place lists) current shall be sufficient justification to withhold a retained percentage from the monthly pay application.

§3.11.4 With regard to as-built, record documents and COBIE construction Data submittals, Contractor shall comply with the requirements set forth in Supplementary Conditions, Section xx.

§ 3.12 Shop Drawings, Product Data and Samples
§ 3.12.1 Shop Drawings are drawings, diagrams, schedules and other data specially prepared for the Work by the Contractor or a Subcontractor, Sub-subcontractor, manufacturer, supplier or distributor to illustrate some portion of the Work.

§ 3.12.2 Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.

§ 3.12.3 Samples are physical examples that illustrate materials, equipment or workmanship and establish standards by which the Work will be judged.

§ 3.12.4 Shop Drawings, Product Data, Samples and similar submittals are not Contract Documents. Their purpose is to demonstrate the way by which the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents for those portions of the Work for which the Contract Documents require submittals. Review by the Owner’s Representative and Construction Manager is subject to the limitations of Section 4.2.7. Informational submittals upon which the Construction Manager and Owner’s Representative are not expected to take responsive action may be so identified in the Contract Documents. Submittals that are not required by the Contract Documents may be returned by the Construction Manager or Owner’s Representative without action.

§ 3.12.5 The Contractor shall review for compliance with the Contract Documents, approve and submit to the Construction Manager Shop Drawings, Product Data, Samples and similar submittals required by the Contract Documents in accordance with the Project submittal schedule approved by the Construction Manager and Owner’s Representative, or in the absence of an approved Project submittal schedule, with reasonable promptness and in such sequence as to cause no delay in the Work or in the activities of other Multiple Prime Contractors or the Owner’s own forces. The Contractor shall cooperate with the Construction Manager in the coordination of the Contractor’s Shop Drawings, Product Data, Samples and similar submittals with related documents submitted by other Multiple Prime Contractors. Shop Drawings shall show: (i) the job title, names of Contractor or Subcontractor, the date and the location of each item shown; (ii) the design, dimensions, connections, and other details necessary to ensure that they accurately interpret the Drawings and Specifications; and (iii) adjoining work in sufficient detail to show proper connection with the same. Where adjoining work requires Shop Drawings, they shall be coordinated and submitted at the same time so that connections can be properly received.

§ 3.12.6 By submitting Shop Drawings, Product Data, Samples and similar submittals, the Contractor represents to the Owner, Construction Manager, and Owner’s Representative, that the Contractor has (1) reviewed and approved them, (2) determined and verified materials, field measurements and field construction criteria related thereto, or will do so and (3) checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.

§ 3.12.7 The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples or similar submittals until the respective submittal has been reviewed and approved by the Owner’s Representative.

§ 3.12.8 The Work shall be in accordance with approved submittals except that the Contractor shall not be relieved of responsibility for deviations from requirements of the Contract Documents by the Owner’s Representative’s approval of Shop Drawings, Product Data, Samples or similar submittals unless the Contractor has specifically informed the Construction Manager and Owner’s Representative in writing of such deviation at the time of submittal and (1) the Owner’s Representative has given written approval to the specific deviation as a minor change in the Work, or (2) a Construction Change Directive in accordance with Section 7.2 has been issued authorizing the deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples or similar submittals by the Owner’s Representative’s approval thereof.
§ 3.12.9 The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data, Samples or similar submittals, to revisions other than those requested by the Construction Manager and Owner’s Representative on previous submittals. In the absence of such written notice, the Owner’s Representative’s approval of a resubmission shall not apply to such revisions.

§ 3.12.10 The Contractor shall not be required to provide professional services which constitute the practice of architecture or engineering unless such services are specifically required by the Contract Documents for a portion of the Work or unless the Contractor needs to provide such services in order to carry out the Contractor’s responsibilities for construction means, methods, techniques, sequences and procedures. In no event shall Contractor be required to provide professional services in violation of applicable law. If professional design services or certifications by a design professional related to systems, materials or equipment are specifically required of the Contractor by the Contract Documents (“Performance Specifications”), the Contract Documents shall specify all performance and design criteria that such services must satisfy. If the Contract Documents applicable to Contractor’s Work include Performance Specifications, then Contractor agrees that (i) the Performance Specifications are achievable by Contractor; (ii) the Contract Sum includes all design services related to or required for achievement of Performance Specifications; (iii) unless the Owner otherwise agrees, all design services related to the Performance Specifications shall be performed by qualified design professionals selected and paid by Contractor, and in conjunction therewith, Contractor shall (a) submit to Owner and Owner’s Representative the names and qualifications of each proposed design professional, (b) make no substitution of such design professional without the prior written consent of Owner and Owner’s Representative, (c) if any such design professional is terminated, provide the services of another licensed design professional acceptable to Owner and Owner’s Representative; and (iv) unless the Owner otherwise agrees, such design professional shall maintain professional liability insurance in amounts and upon terms and conditions satisfactory to Owner. The signature and seal of such design professional shall appear on all drawings, calculations, specifications, certifications, Shop Drawings and other submittals prepared by design professional. Shop Drawings or other Submittals related to the Work designed or certified by others shall bear design professional’s written approval when submitted to the Owner’s Representative. Contractor shall provide the design professional providing the certification with full information as to the relevant performance requirements and the conditions under which the materials, systems, or equipment will be expected to operate as a part of the completed Work. This certification shall be based on performance under the operating conditions at the Project Site and as a part of the completed Work. The Owner and the Owner’s Representative shall be entitled to rely upon the adequacy, accuracy and completeness of the services, certifications or approvals performed by Contractor’s design professionals, provided that the Owner and Owner’s Representative have specified to the Contractor all performance and design criteria that such services must satisfy. Owner’s Representative’s review of such submittals shall be only for the limited purpose of checking for conformance with information given and design concept expressed in the Contract Documents. The Contractor shall not be responsible for the adequacy of the performance or design criteria required by the Contract Documents, but if Contractor discovers or is informed of any error or inadequacy in such criteria then Contractor shall promptly notify the Owner and Owner’s Representative in writing.

§ 3.12.11 The Electrical Contractor shall review, coordinate and approve its Shop Drawings and the Shop Drawings of its Subcontractors. The Mechanical Contractor shall review, coordinate and approve its Shop Drawings, the Shop Drawings of its Subcontractors and the mechanical Shop Drawings with the electrical Shop Drawings. The General Contractor shall review, coordinate and approve its Shop Drawings, the Shop Drawings of its Subcontractors and the Shop Drawings of the other Prime Contractors.

§ 3.13 Use of Site
§ 3.13.1 The Contractor shall confine operations at the site to areas permitted by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities and the Contract Documents and shall not unreasonably encumber the site with materials or equipment. The Construction Manager shall prepare an overlay sketch of the construction areas indicating thereon spaces assigned for field offices, trailers, storage sheds, field shops and similar facilities and storage of materials for all trades. All such overlying sketches must indicate that the Construction areas shown therein are in compliance with the Americans with Disabilities Act and other applicable law.

§ 3.13.2 The Contractor shall coordinate the Contractor’s operations with, and secure the approval of, the Construction Manager before using any portion of the site. Notwithstanding any designation of site limits or the indication of temporary fences or barricades, provisions of the Contract Documents governing portions or phases of
the Work may require that certain operations be carried out beyond such designated limits. Trenching, utility work, site development, landscaping and other such work, if required beyond such designated limits, shall be scheduled in such manner as to cause a minimum of inconvenience, disturbance to or interference with the normal operations of the Owner, abutters, and the public. The Contractor shall obtain the Construction Manager's prior approval for such operations, prosecute such operations expeditiously and restore the affected area and other areas needed for access to their original condition immediately upon completion of such operation unless the Contract Documents otherwise specify.

§ 3.13.3 Pumping, draining and control of surface and groundwater shall be carried out so as to avoid endangering any adjacent facility or property, or interrupting, restricting or otherwise infringing, or interfering with the use thereof. All such work shall be performed in compliance with state and federal regulations and any other authority applicable to the site with respect to surface and groundwater and shall be at no additional cost to the Owner.

§ 3.13.4 The discharge of any substance other than stormwater into any storm drain, inlet, creek, or ditch, including street gutters and curb inlets, is strictly prohibited, unless the substance is only of the following exempt discharges: water line flushing, landscape irrigation, diverted stream flows, rising groundwater infiltration, uncontaminated pumped groundwater, discharges from potable water sources, foundation drains, air conditioning condensation, irrigation water, springs, water from crawl space pumps, footing drains, lawn watering, individual residential car washing, flows from riparian, habitats and wetlands, dechlorinated swimming pool discharges, street wash water, or discharges from firefighting activities. The discharge of sediment-laden runoff waters from construction sites is included as a prohibited discharge. Contractor shall pay Owner for any costs Owner incurs based upon Contractor's noncompliance with this provision, including but not limited to repair or remediation costs, fines or penalties imposed on Owner by any regulating authority, and any fees or costs paid to attorneys or consultants arising out of a prohibited discharged. Failure to comply with this provision may also, at the Owner's sole option, result in Owner's termination of this Contract. In the event that Owner terminates the Contract based on a violation of this provision, Contractor agrees that Owner shall have no further liability to Contractor, with the exception of payment of any monies for work Contractor performed prior to the date of termination.

§ 3.13.5 Only materials and equipment that are to be used in the Work shall be brought to and stored on the Project Site by the Contractor. Equipment no longer required for the Work shall be promptly removed from the Project Site. Contractor shall be solely responsible for protecting construction materials and equipment stored at the Project Site from weather, theft, damage and all other adversity. The Contractor shall ensure that at all times, the Work is performed in a manner that provides reasonable vehicular and pedestrian access to site of the Work and all adjacent areas. To the fullest extent reasonably possible, the Work shall be performed in such manner that public areas adjacent to the site of the Work shall be free from all debris, building materials, equipment or hazardous conditions.

§ 3.13.6 Neither Contractor nor any entity for which the Contractor is responsible, shall erect any sign on the Project Site without the Owner's prior written consent. Such consent may be withheld in the Owner's sole discretion.

§ 3.13.7 Without limiting any other provision of the Contract Documents, Contractor shall use its best efforts to minimize any interference with the occupancy or beneficial use of (i) any areas in buildings adjacent to the site of the Work and (ii) the Project itself in the event of Beneficial Occupancy, as permitted in Section 8.4. Without the Owner's prior written approval, Contractor shall not permit any workers to use any existing facilities at the Project Site, including without limitation, lavatories, toilets, entrances and parking areas other than those designated by the Owner for Contractor's use.

.2 The Contractor shall comply with all insurance requirements and collective bargaining agreements applicable to use and occupancy of the Project Site and the Work.
§ 3.13.8 In addition to the requirements identified in this Section, Contractor shall comply with the requirements set forth in the Indiana University Project Site Requirements.

§ 3.14 Cutting and Patching
§ 3.14.1 The Contractor shall be responsible for cutting, fitting or patching required to complete the Work or to make its parts fit together properly. All areas requiring cutting, fitting and patching shall be restored to the condition existing prior to the cutting, fitting and patching, unless otherwise required by the Contract Documents.

§ 3.14.2 The Contractor shall not damage or endanger a portion of the Work or any fully or partially completed construction of the Owner or separate contractors by excavating, cutting, patching or otherwise altering such construction. The Contractor shall not cut or otherwise alter such construction by the Owner or a separate contractor except with written consent of the Construction Manager, Owner and such contractor. Such consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold from the Owner or a separate contractor the Contractor’s consent to cutting or otherwise altering the Work. All excavating, cutting and/or patching shall be performed in such a manner as to protect other structures, monuments, brick sidewalks, trees and other landscaping.

.1 Cutting and patching shall be performed by the proper trades or crafts necessary for the material involved, at the cost of the contractor requiring the cutting and patching.

.2 Patching shall mean the restoration of a surface or item to its original condition to match the existing adjoining surfaces unless otherwise indicated, noted, detailed or specified. When patching involves painting, special coating, vinyl fabric or other applied finishes, the entire surface affected (i.e. wall or ceiling) shall be refinished as a part of this requirement.

.3 Cutting and patching includes cleaning and restoration of all surfaces soiled by the cutting and patching work.

§ 3.14.3 Contractor shall locate and protect from injury utilities of all kinds, either above or below grade, inside or outside of any structure, found in the area affected by its Work. Contractor shall be responsible for all damage caused to such utility by the operation of equipment or delivery of materials or as the direct or indirect result of any of its Work and shall repair all such damage at its expense and as a part of the Work included in the Contract Documents. The Contractor shall not be entitled to any increase in the Contract Sum or the Contract Time on account of such damage to any utility. Upon discovery of any utility by Contractor, such utility shall be indicated on the As Built Drawings.

§ 3.15 Cleaning Up
§ 3.15.1 The Contractor shall daily keep the premises and surrounding area free from accumulation of waste materials or rubbish caused by its operations. At completion of the Work, the Contractor shall remove from and about the Project waste materials, rubbish and the Contractor’s tools, construction equipment, machinery and surplus materials. Additional requirements are set forth in the Supplementary Conditions, Section 10.

§ 3.15.1.1 The Contractor shall be responsible for keeping the site of the Work and adjacent premises as free from material, debris and rubbish as is practicable, and shall remove same from any portion of the Site, if, in the opinion of the Owner or Owner’s Representative, such material debris or rubbish constitutes a health and safety issue, nuisance or is objectionable in any way to the Owner. The Contractor further agrees to remove all machinery, materials implements, barricades, staging, false work, debris and rubbish connected with or caused by its Work immediately upon completion of the Work and to clean all structures and Work under the Contract Documents to the satisfaction the Owner and the Owner’s Representative and to leave the premises in perfect condition in so far as affected by the Work hereunder. With respect to renovation projects, the Contractor acknowledges that Owner in such cases, may continue to occupy and must maintain continuous operations in the building in which the Work is located. In such cases, it is critical that Owner’s operations not suffer any significant interference, including, without limitation, any interruption in utilities or unreasonable noise, dust, odor, vibration or hazardous condition. The Contractor shall perform its Work and limit its use of the Project Site in such manner as to minimize any interference with Owner’s occupancy and operations in the building consistent with applicable building rules and regulations.
§ 3.15.1.2 Dust control shall be effectively maintained at all times whether or not specifically ordered by the Owner’s Representative or Owner. The Contractor shall provide and apply continuous internal and external dust control, including holidays and weekends, as required, to prevent the spread of dust and to avoid the creation of a nuisance at the work site or in the surrounding areas as a result of construction activities. Internal dust control shall be accomplished by barrier, vacuum, filters or other approved methods and equipment. External dust control shall be by sprinkler water or other approved means, except that no chemicals or oil shall be used. Quantities and equipment shall be sufficient to control dust effectively. When weather conditions warrant, external sprinkling equipment shall be on hand and immediately available at all times. Owner’s Representative and Owner shall have the authority to order dust control Work whenever required in its opinion; however, dust control shall be effectively maintained at all times whether or not specifically ordered by the Owner’s Representative and Owner. Contractor shall also take proper measures at no additional cost to Owner to prevent tracking mud into the interior of buildings or onto public streets or roads or property of third persons. Such measures shall include but are not limited to covering muddy areas on the Site with clean dry sand. All ingress/egress from the Site shall be maintained in a dry condition, and any mud tracked onto the public streets or roads or any other areas of the building or property of third persons shall be immediately removed and the affected area cleaned. Owner’s Representative or Owner may order such work at any time that conditions warrant.

§ 3.15.1.3 The General Contractor shall be ultimately responsible for all daily cleanup of construction materials and debris and building dust control. Cleanup shall include removal of materials and debris from the building and placement in a debris box or other disposal. Special consideration is required for the immediate removal and/or protection of material or debris which pose a hazard to Owner’s students, employees, invitees, fixtures and floor coverings (i.e. hazardous materials, broken glass, sawdust, materials that pose a tripping hazard, etc.), including utilization of protective coverings for newly installed floor covering and fixtures. Certain construction activities, including but not limited to drywall sanding, spray painting, sawing, etc., create dust which must be controlled to protect Owner’s students, employees, invitees, equipment, facilities and property. Each Prime Contractor shall take steps as necessary to control the dust created by these operations, including but not limited to Visquine, ventilation, or a solid construction barrier. In addition to the requirements identified in this Section, Contractor shall comply with the requirements regarding airborne contaminants set forth in the Project Specifications.

§ 3.15.2 If the General Contractor fails to clean up as required by the Contract Documents, the Owner may do so and the cost thereof shall be charged to the General Contractor. When reasonably necessary, Owner may exercise its right to clean up during evening, weekend and holiday hours and any premium time charges associated therewith will be charged to the General Contractor.

§ 3.16 Access to Work
The Contractor shall provide the Owner, Construction Manager and Owner’s Representative access to the Work in preparation and progress wherever located. If Work is being performed at locations other than the Project Site, Contractor shall notify the Owner’s Representative of such locations, and the time such work will be ready for observation prior to its delivery to the Project Site.

§ 3.17 Royalties, Patents and Copyrights
The Contractor shall pay all royalties and license fees. The Contractor shall defend suits or claims for infringement of copyrights and patent rights and shall hold the Owner, Construction Manager and Owner’s Representative harmless from loss on account thereof, but shall not be responsible for such defense or loss when a particular design, process or product of a particular manufacturer or manufacturers is required by the Contract Documents or where the copyright violations are contained in Drawings, Specifications or other documents prepared by the Owner, Owner’s Representative, or Construction Manager. However, if the Contractor has reason to believe that the required design, process or product is an infringement of a copyright or a patent, the Contractor shall be responsible for such loss unless such information is promptly furnished to the Owner’s Representative through the Construction Manager.

§ 3.18 Indemnification
§ 3.18.1 To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless the Owner, Construction Manager, Owner’s Representative, Construction Manager’s and Owner’s Representative’s consultants, and agents and employees of any of them from and against claims, damages, losses and expenses, including but not limited to reasonable attorneys’ fees, arising out of or resulting from performance of the Work, provided that such claim, damage, loss or expense is attributable to bodily injury, sickness, disease or death, or injury to or destruction of tangible property (other than the Work itself) but only to the extent caused by the negligent acts or omissions of
the Contractor, a Subcontractor, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss or expense is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge or reduce other rights or obligations of indemnity that would otherwise exist as to a party or person described in this Section 3.18.

§ 3.18.2 In claims against any person or entity indemnified under this Section 3.18 by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, the indemnification obligation under Section 3.18.1 shall not be limited by a limitation on amount or type of damages, compensation or benefits payable by or for the Contractor or a Subcontractor under workers’ compensation acts, disability benefit acts or other employee benefit acts.

§ 3.18.3 The Contractor’s indemnity obligations under this Section 3.18 specifically include, without limitation, all fines, penalties, damages, liability, cost, expenses (including without limitation reasonable attorneys’ fees), and punitive damages, if any, arising out of, or in connection with any (i) violation of or failure to comply with any law, statute, ordinance, rule, regulation, code, or requirement of a public authority that bears upon the performance of the Work by the Contractor, a Subcontractor or any person or entity for whom either is responsible, (ii) means, methods, procedures, techniques, or sequences of execution or performance of the Work, and (iii) failure to secure and pay for permits, fees, approvals, licenses, and inspections as required under the Contract Documents, or any violation of any permit or other approval of a public authority applicable to the Work by the Contractor, a subcontractor, or any person or entity for whom either is responsible.

§ 3.18.4 The Contractor shall indemnify and hold harmless all of the indemnitees from and against any costs and expenses (including reasonable attorneys’ fees) incurred by any of the Indemnitees in enforcing any of the Contractor’s defense, indemnity, and hold harmless obligations under this Contract.

§ 3.18.5 Whenever the Contract Documents entitle the Owner to recover its reasonable attorneys’ fees, the term "reasonable attorneys’ fees" shall include, without limitation, the following related expenses paid or incurred by the Owner: (i) attorneys’ fees; (ii) paralegal fees; (iii) documentary evidence and expert witness costs; (iv) court reporter charges; (v) filing fees, recording fees, copying charges and the like; and (vi) travel, lodging and meal expense.

ARTICLE 4 OWNER’S REPRESENTATIVE AND CONSTRUCTION MANAGER

§ 4.1 General

§ 4.1.1 The Owner shall retain an architect or engineer lawfully licensed to practice architecture or engineering or an entity lawfully practicing architecture or engineering in the jurisdiction where the Project is located. That person or entity is identified as the Owner’s Representative in the Agreement and is referred to throughout the Contract Documents as if singular in number. To the extent that the Project does not involve the practice of architecture or engineering but instead involves the practice of another licensed profession, the term ‘Owner’s Representative,’ as used herein, shall refer to such other licensed design professional.

§ 4.1.2 The Owner shall retain a construction manager lawfully licensed to practice construction management or an entity lawfully practicing construction management in the jurisdiction where the Project is located. That person or entity is identified as the Construction Manager in the Agreement and is referred to throughout the Contract Documents as if singular in number.

§ 4.1.3 Duties, responsibilities and limitations of authority of the Construction Manager and Owner’s Representative as set forth in the Contract Documents shall not be restricted, modified or extended without written consent of the Owner, Construction Manager, Owner’s Representative and Contractor. Consent shall not be unreasonably withheld.

§ 4.1.4 If the employment of the Construction Manager or Owner’s Representative is terminated, the Owner shall employ a successor construction manager or owner’s representative as to whom the Contractor has no reasonable objection and whose status under the Contract Documents shall be that of the Construction Manager or Owner’s Representative, respectively.

§ 4.2 Administration of the Contract

§ 4.2.1 The Construction Manager and Owner’s Representative will provide administration of the Contract as described in the Contract Documents during construction until the date the Owner’s Representative issues the final Certificate for Payment, and, with the Owner’s concurrence, from time to time during the two-year period for correction of the Work. The Construction Manager and Owner’s Representative will have authority to act on behalf
of the Owner only to the extent provided in the Contract Documents.

§ 4.2.2 The Owner’s Representative will visit the site at intervals appropriate to the stage of construction, or as otherwise agreed with the Owner, to become generally familiar with the progress and quality of the portion of the Work completed, and to determine in general if the Work observed is being performed in a manner indicating that the Work, when fully completed, will be in accordance with the Contract Documents. However, the Owner’s Representative will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. The Owner’s Representative will not have control over, charge of, or responsibility for, the construction means, methods, techniques, sequences or procedures, or for the safety precautions and programs in connection with the Work, since these are solely the Contractor’s rights and responsibilities under the Contract Documents, except as provided in Section 3.3.1.

§ 4.2.3 On the basis of the site visits, the Owner’s Representative will keep the Owner reasonably informed about the progress and quality of the portion of the Work completed, and report to the Owner (1) known deviations from the Contract Documents and from the most recent construction schedule submitted by the Contractor, and (2) defects and deficiencies observed in the Work. The Owner’s Representative will not be responsible for the Contractor’s failure to perform the Work in accordance with the requirements of the Contract Documents. The Owner’s Representative will not have control over or charge of and will not be responsible for acts or omissions of the Contractor, Subcontractors, or their agents or employees, or any other persons or entities performing portions of the Work.

§ 4.2.4 The Construction Manager shall provide a staffing plan to include one or more representatives who shall be in attendance at the Project site whenever the Work is being performed. The Construction Manager will determine in general if the Work observed is being performed in accordance with the Contract Documents, will keep the Owner reasonably informed of the progress of the Work, and will report to the Owner and Owner’s Representative (1) known deviations from the Contract Documents and the most recent Project schedule, and (2) defects and deficiencies observed in the Work.

§ 4.2.5 The Construction Manager will schedule and coordinate the activities of the Contractor and other Prime Contractors in accordance with the latest approved Project schedule.

§ 4.2.6 The Construction Manager, except to the extent required by Section 4.2.4, and Owner’s Representative will not have control over, or charge of, construction means, methods, techniques, sequences or procedures, or for the safety precautions and programs in connection with the Work, since these are solely the Contractor’s rights and responsibilities under the Contract Documents, except as provided in Section 3.3.1, and neither will be responsible for the Contractor’s failure to perform the Work in accordance with the requirements of the Contract Documents. Neither the Construction Manager nor the Owner’s Representative will have control over or charge of or be responsible for acts or omissions of the Contractor, Subcontractors, or their agents or employees, or of any other persons or entities performing portions of the Work.

§ 4.2.7 Communications Facilitating Contract Administration. Except as otherwise provided in the Contract Documents or when direct communications have been specially authorized, the Owner and Contractor shall endeavor to communicate with each other through the Construction Manager, and shall contemporaneously provide the same communications to the Owner’s Representative about matters arising out of or relating to the Contract Documents. Communications by and with the Owner’s Representative’s consultants shall be through the Owner’s Representative. Communications by and with Subcontractors and material suppliers shall be through the Contractor. Communications by and with other Multiple Prime Contractors shall be through the Construction Manager and shall be contemporaneously provided to the Owner’s Representative if those communications are about matters arising out of or related to the Contract Documents. Communications by and with the Owner’s own forces shall be through the Owner.

§ 4.2.8 Based on the Construction Manager’s evaluations of the Contractor’s Applications for Payment, the Owner’s Representative will review and certify the amounts due the Contractor and will issue Certificates for Payment in such amounts.

§ 4.2.9 The Owner’s Representative and Construction Manager have authority to reject Work that does not conform to the Contract Documents and will notify each other about the rejection. The Construction Manager shall determine in general whether the Work of the Contractor is being performed in accordance with the requirements of the
Contract Documents and notify the Owner, Contractor and Owner’s Representative of defects and deficiencies in the Work. Whenever the Construction Manager considers it necessary or advisable, the Construction Manager will have authority to require additional inspection or testing of the Work in accordance with Sections 13.5.2 and 13.5.3, upon written authorization of the Owner, whether or not such Work is fabricated, installed or completed. The foregoing authority of the Construction Manager will be subject to the provisions of to the interpretations and decisions of the Owner’s Representative. However, neither the Owner’s Representative’s nor the Construction Manager’s authority to act under this Section 4.2.9 nor a decision made by either of them in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the Owner’s Representative or the Construction Manager to the Contractor, Subcontractors, material and equipment suppliers, their agents or employees, or other persons or entities performing any of the Work.

§ 4.2.10 The Construction Manager will receive and promptly review for conformance with the submittal requirements of the Contract Documents, all submittals from the Contractor such as Shop Drawings, Product Data and Samples. Where there are Multiple Prime Contractors, the Construction Manager will also check and coordinate the information contained within each submittal received from Contractor and other Multiple Prime Contractors, and transmit to the Owner’s Representative those recommended for approval. By submitting Shop Drawings, Product Data, Samples and similar submittals, the Construction Manager represents to the Owner and Owner’s Representative that the Construction Manager has reviewed and recommended them for approval. The Construction Manager’s actions will be taken in accordance with the Project submittal schedule approved by the Owner’s Representative or, in the absence of an approved Project submittal schedule, with reasonable promptness while allowing sufficient time to permit adequate review by the Owner’s Representative.

§ 4.2.11 The Owner’s Representative will review and approve or take other appropriate action upon the Contractor’s submittals such as Shop Drawings, Product Data and Samples, but only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Owner’s Representative’s action will be taken in accordance with the submittal schedule approved by the Owner’s Representative or, in the absence of an approved submittal schedule, with reasonable promptness while allowing sufficient time in the Owner’s Representative’s professional judgment to permit adequate review. Upon the Owner’s Representative’s completed review, the Owner’s Representative shall transmit its submittal review to the Construction Manager.

§ 4.2.12 Review of the Contractor’s submittals by the Construction Manager and Owner’s Representative is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Contractor as required by the Contract Documents. The Construction Manager and Owner’s Representative’s review of the Contractor’s submittals shall not relieve the Contractor of the obligations under Sections 3.3, 3.5 and 3.12. The Construction Manager and Owner Representative’s review shall not constitute approval of safety precautions or, unless otherwise specifically stated by the Construction Manager and Owner’s Representative, of any construction means, methods, techniques, sequences or procedures. The Owner Representative’s approval of a specific item shall not indicate approval of an assembly of which the item is a component.

§ 4.2.13 The Construction Manager will prepare Construction Change Directives.

§ 4.2.14 The Construction Manager and the Owner’s Representative will take appropriate action on Construction Change Directives in accordance with Article 7, and the Owner’s Representative will have authority to order minor changes in the Work as provided in Section 7.4. The Owner’s Representative, in consultation with the Construction Manager, will investigate and make determinations and recommendations regarding concealed and unknown conditions as provided in Section 3.7.4.

§ 4.2.15 Utilizing the documents provided by the Contractor, the Construction Manager will maintain at the site for the Owner one copy of all Contract Documents, approved Shop Drawings, Product Data, Samples and similar required submittals, in good order and marked currently to record all changes and selections made during construction. These will be available to the Owner’s Representative and the Contractor, and will be delivered to the Owner upon completion of the Project.

§ 4.2.16 The Construction Manager will assist the Owner’s Representative in conducting inspections to determine the dates of Substantial Completion and the date of final completion; issue Certificates of Substantial Completion in
conjunction with the Owner’s Representative pursuant to Section 9.8; and receive and forward to the Owner written warranties and related documents required by the Contract and assembled by the Contractor pursuant to Section 9.10. The Construction Manager will forward to the Owner’s Representative a final Application and Certificate for Payment or final Project Application and Project Certificate for Payment upon the Contractor’s compliance with the requirements of the Contract Documents.

§ 4.2.17 If the Owner and Owner’s Representative agree, the Owner’s Representative will provide one or more project representatives to assist in carrying out the Owner Representative’s responsibilities at the site. The duties, responsibilities and limitations of authority of such project representatives shall be as set forth in an exhibit to be incorporated in the Contract Documents.

§ 4.2.18 The Owner’s Representative will interpret and decide matters concerning performance under, and requirements of the Contract Documents on written request of the Construction Manager, Owner or Contractor through the Construction Manager. The Owner’s Representative’s response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness.

§ 4.2.19 Interpretations and decisions of the Owner’s Representative will be consistent with the intent of and reasonably inferable from the Contract Documents and will be in writing or in the form of drawings. When making such interpretations and decisions, the Owner’s Representative will endeavor to secure faithful performance by both Owner and Contractor, will not show partiality to either and will not be liable for results of interpretations or decisions so rendered in good faith.

§ 4.2.20 The Owner’s Representative’s decisions on matters relating to aesthetic effect will be final if consistent with the intent expressed in the Contract Documents.

§ 4.2.21 The Construction Manager will receive and review requests for information from the Contractor, and forward each request for information to the Owner’s Representative, with the Construction Manager’s recommendation. The Owner’s Representative will review and respond in writing to the Construction Manager to requests for information about the Contract Documents. The Construction Manager’s recommendation and the Owner’s Representative’s response to each request will be made in writing within any time limits agreed upon or otherwise with reasonable promptness. If appropriate, the Owner’s Representative will prepare and issue supplemental Drawings and Specifications in response to the requests for information.

ARTICLE 5 SUBCONTRACTORS

§ 5.1 Definitions

§ 5.1.1 A Subcontractor is a person or entity who has a direct contract with the Contractor to perform a portion of the Work at the site. The term “Subcontractor” is referred to throughout the Contract Documents as if singular in number and means a Subcontractor or an authorized representative of the Subcontractor. The term “Subcontractor” does not include a separate contractor or subcontractors of a separate contractor.

§ 5.1.2 A Sub-subcontractor is a person or entity who has a direct or indirect contract with a Subcontractor to perform a portion of the Work at the site. The term “Sub-subcontractor” is referred to throughout the Contract Documents as if singular in number and means a Sub-subcontractor or an authorized representative of the Sub-subcontractor.

§ 5.2 Award of Subcontracts and Other Contracts for Portions of the Work

§ 5.2.1 Unless otherwise stated in the Contract Documents or the bidding requirements, the Contractor, as soon as practicable after award of the Contract, shall furnish in writing to the Construction Manager for review by the Owner, Construction Manager and Owner’s Representative the names of persons or entities (including those who are to furnish materials or equipment fabricated to a special design) proposed for each principal portion of the Work. Contractor shall not propose or utilize a Subcontractor who has been disqualified under existing federal laws and regulations from participating in federally-assisted construction projects. The Contractor shall contract only with a Subcontractor approved in writing by the Owner and, after bid opening, substitution of any Subcontractor identified in the bid shall be made only by way of the Construction Change Directive process set forth in Article 7 of this Agreement. Additionally, the Contractor may not adjust its bid price, and may not seek a refund of its bid bond, based upon Owner's rejection of any Subcontractor or of a proposed substitution. The Construction Manager may reply within 14 days to the Contractor in writing stating (1) whether the Owner, the Construction Manager or the Owner’s Representative has reasonable objection to any such proposed person or entity or, (2) that the Construction
Manager, Owner’s Representative or Owner requires additional time for review. Failure of the Construction Manager, Owner, or Owner’s Representative to reply within the 14-day period shall constitute notice of no reasonable objection.

§ 5.2.2 The Contractor shall not contract with any Subcontractor without the Owner’s and Owner’s Representative’s prior written approval, which shall not be granted until Contractor submits a written statement concerning the proposed award to the Subcontractor that contains such information as the Owner may require. The Owner shall issue a written approval or rejection of each proposed award within ten (10) days of the Bid Opening. The Contractor shall not contract with a proposed person or entity whom the Owner and/or Owner’s Representative has timely rejected.

§ 5.2.3 If the Owner, Construction Manager or Owner’s Representative has reasonable objection to a person or entity proposed by the Contractor, the Contractor shall propose another to whom the Owner, Construction Manager or Owner’s Representative has no reasonable objection. In the event that the Contractor is required to substitute a Subcontractor during the course of the Work, such substitution shall be made only by way of the Construction Change Directive process set forth in Article 7 of this Agreement. The Contractor may not adjust its price based upon such a substitution or upon Owner’s rejection of any proposed substitute Subcontractor.

§ 5.2.4 The Contractor shall not substitute a Subcontractor, person or entity previously selected if the Owner, Construction Manager or Owner’s Representative makes reasonable objection to such substitution.

§ 5.3 Subcontractual Relations
By written agreement, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by the terms of the Contract Documents, including but not limited to the process set forth in Section 7.2.5 by which profit and overhead on Construction Change Directives is calculated, and to assume toward the Contractor all the obligations and responsibilities, including the responsibility for safety of the Subcontractor’s Work, which the Contractor, by these Contract Documents, assumes toward the Owner, Construction Manager and Owner’s Representative. Each subcontract agreement shall preserve and protect the rights of the Owner, Construction Manager and Owner’s Representative with respect to the Work to be performed by the Subcontractor so that the subcontracting thereof will not prejudice such rights. Where appropriate, the Contractor will make available to each proposed Subcontractor, prior to the execution of the subcontract agreement, copies of the Contract Documents to which the Subcontractor will be bound. Subcontractors will similarly make copies of applicable portions of such documents available to their respective proposed Subcontractors. The Contract Documents shall not create, or be construed to create, any contractual relationship between any Subcontractor and the Owner.

§ 5.4 Contingent Assignment of Subcontracts
§ 5.4.1 Each subcontract agreement for a portion of the Work is assigned by the Contractor to the Owner, provided that

1. assignment is effective only after termination of the Contract by the Owner for cause pursuant to Section 14.2 and only for those subcontract agreements that the Owner accepts by notifying the Subcontractor and Contractor in writing; and

2. assignment is subject to the prior rights of the surety, if any, obligated under bond relating to the Contract.

When the Owner accepts the assignment of a subcontract agreement, the Owner assumes the Contractor’s rights and obligations under the subcontract.

§ 5.4.2 If a Subcontractor’s Work has been suspended for more than thirty (30) days after termination of the Agreement by the Owner and the Owner accepts assignment of such Subcontract, the Subcontractor’s compensation shall be equitably adjusted for any increase in direct costs incurred by such Subcontractor as a result of the suspension. In no event shall such adjustment include any consequential damages as that term is used in Section 15.1.6.

§ 5.4.3 Upon such assignment to the Owner under this Section 5.4, the Owner may further assign the subcontract to a successor contractor or other entity. If the Owner assigns the subcontract to a successor contractor or other entity, the Owner shall nevertheless remain legally responsible for all of the successor contractor’s obligations under the subcontract, unless otherwise agreed in writing.
ARTICLE 6 CONSTRUCTION BY OWNER OR BY OTHER CONTRACTORS

§ 6.1 Owner’s Right to Perform Construction with Own Forces and to Award Other Contracts

§ 6.1.1 The Owner reserves the right to perform construction or operations related to the Project with the Owner’s own forces, which include persons or entities under separate contracts not administered by the Construction Manager, and to award other contracts in connection with other portions of the Project or other construction or operations on the site under Conditions of the Contract identical or substantially similar to those including those portions related to insurance and waiver of subrogation. Claims by Contractor arising out of such action by the Owner shall be governed by Sections 8.3 (Delays and Extensions of Time) and Article 15 (Claims).

§ 6.1.2 When the Owner performs construction or operations with the Owner’s own forces including persons or entities under separate contracts not administered by the Construction Manager, the Owner shall provide for coordination of such forces with the Work of the Contractor, who shall cooperate with them.

§ 6.1.3 The Owner shall provide for coordination of the activities of the Owner’s own forces and of each separate contractor with the Work of the Contractor, who shall cooperate with them. The Contractor shall participate with other separate contractors and the Owner in reviewing their Construction Schedules. The Contractor shall make any revisions to the Construction Schedule deemed necessary after a joint review and mutual agreement. The Construction Schedules shall then constitute the schedules to be used by the Contractor, separate contractors and the Owner until subsequently revised.

§ 6.1.4 Unless otherwise provided in the Contract Documents, when the Owner performs construction or operations related to the Project with the Owner’s own forces, the Owner shall be deemed to be subject to the same obligations and to have the same rights that apply to the Contractor under the Conditions of the Contract, including, without excluding others, those stated in Article 3, this Article 6 and Articles 10, 11 and 12.

§ 6.1.5 The Contractor accepts assignment of, and liability for, all purchase orders and other agreements for procurement of materials and equipment that are identified as part of the Contract Documents. The Contractor shall be responsible for any such purchased items as if the Contractor were the original purchaser. The Contract sum includes, without limitation, all costs and expenses in connection with delivery, storage, insurance, installation, and testing of items covered in any assigned purchase orders or agreements. Unless the Contract Documents specifically provide otherwise, all warranty and correction of the Work obligations included in the Contract Documents shall apply to any pre-purchased items.

§ 6.1.6 The Owner may elect to assign certain contractors to a single Prime Contractor or to the Construction Manager for coordination and scheduling purposes only. Such Prime Contractor or the Construction Manager, as to such assigned contractors, shall be responsible, in accordance with Sections 3.3.1 and 3.10.1, for all Project scheduling, construction, coordination, general superintendence and for reviewing and approving the assigned contractor’s periodic applications for payment. The Owner shall make periodic payments directly to each assigned contractor after approval of the Prime Contractor Construction Manager, the Owner and the Owner’s Representative. Approval of assigned contractor’s periodic applications for payment shall not be unreasonably withheld by the Prime Contractor or the Construction Manager.

§ 6.2 Mutual Responsibility

§ 6.2.1 The Contractor shall afford the Owner, separate contractors, Construction Manager and other Prime Contractors reasonable opportunity for introduction and storage of their materials and equipment and performance of their activities, and shall connect and coordinate the Contractor’s construction and operations with theirs as required by the Contract Documents.

§ 6.2.2 If part of the Contractor’s Work depends for proper execution or results upon construction or operations by the Owner, a separate contractor or other Prime Contractors, the Contractor shall, prior to proceeding with that portion of the Work, promptly report to the Construction Manager and Owner’s Representative apparent discrepancies or defects in such other construction that would render it unsuitable for such proper execution and results. Failure of the Contractor so to report shall constitute an acknowledgment that the completed or partially completed construction is fit and proper to receive the Contractor’s Work, except as to defects not then reasonably discoverable.
§ 6.2.3 The Contractor shall reimburse the Owner for costs the Owner incurs, including costs that are payable to a separate contractor or Prime Contractor because of the Contractor’s delays, improperly timed activities or defective construction. The Owner shall be responsible to the Contractor for costs the Contractor incurs because of damage to the Work or defective construction by the Owner’s own forces or other Multiple Prime Contractors.

§ 6.2.4 The Contractor shall promptly remedy damage the Contractor wrongfully causes to completed or partially completed construction or to property of the Owner, separate contractors or Prime Contractors as provided in Section 10.2.5.

§ 6.2.5 The Owner, each separate contractor or each Prime Contractor shall have the same responsibilities for cutting and patching as are described for the Contractor in Section 3.14.

§ 6.3 Owner’s Right to Clean Up
If a dispute arises among the Contractor, separate contractors and the Owner as to the responsibility under their respective contracts for maintaining the premises and surrounding area free from waste materials and rubbish, the Owner may clean up and the Construction Manager, with notice to the Owner’s Representative, will allocate the cost among those responsible.

ARTICLE 7 CHANGES IN THE WORK
§ 7.1 General
§ 7.1.1 Changes in the Work may be accomplished after the Notice to Proceed is issued, and without invalidating the Contract, by Construction Change Directive or order for a minor change in the Work, subject to the limitations stated in this Article 7 and elsewhere in the Contract Documents.

§ 7.1.2 When a contemplated change in the Work may affect the Contract Sum or the Contract Time, the Owner’s Representative will issue a Construction Change Directive detailing the work involved in such proposed change. The Contractor shall promptly, but in no case longer than five (5) working days after receipt of such Construction Change Directive, issue a reply or Change Quotation itemizing the cost of such Construction Change Directive and any projected enlargement of the Contract Time or modification of the Project Schedule. Authorization to proceed with the Work shall be in accordance with 7.2.3.

§ 7.1.3 To expedite the review and evaluation of Contractor’s Change Quotations, all Change Quotations (except those so minor that their propriety is obvious on their face) shall include a complete itemization of costs showing quantities, with unit prices of labor and materials for each such quantity, including items furnished by Subcontractors. Where major cost items are provided by Subcontractors, such items also shall be itemized and a copy of the Subcontractor’s quotations, itemized as indicated above, shall be included in the Construction Change Directive. In no case shall a change involving more than Three Thousand Dollars ($3,000) be approved without such itemization.

§ 7.1.4 A Construction Change Directive requires agreement among the Owner, Contractor, Construction Manager and Owner’s Representative; an order for a minor change in the Work may be issued by the Owner’s Representative alone.

§ 7.1.5 Changes in the Work shall be performed under applicable provisions of the Contract Documents. The Contractor shall proceed promptly, unless otherwise provided in the Construction Change Directive or order for a minor change in the Work. Except as provided in Section 9.7.2, a change in the Contract Sum or Contract Time shall be accomplished only by Construction Change Directive. No course of conduct or dealing between the parties, no expressed or implied acceptance of alterations or additions to the Work, and no claim that Owner has been unjustly enriched by any alteration of or addition to the Work, whether or not there is any unjust enrichment to the Work, shall be the basis of any claim for an increase in the Contract Sum or for a change in the Contract Time in the absence of a Construction Change Directive.

§ 7.2 Construction Change Directives
§ 7.2.1 A Construction Change Directive is a written order prepared by the Owner’s Representative and signed by the Owner, Construction Manager and Owner’s Representative, directing a change in the Work prior to agreement on adjustment, if any, in the Contract Sum or Contract Time, or both. The Owner may by Construction Change Directive, without invalidating the Contract, order changes in the Work within the general scope of the Contract.
§ 7.2.2 If the Construction Change Directive provides for an adjustment to the Contract Sum, the adjustment shall be based on one of the following methods:

.1 Mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;

.2 Unit prices stated in the Contract Documents or subsequently agreed upon;

.3 Cost to be determined in a manner agreed upon by the parties in and a mutually acceptable fixed or percentage fee;

.4 time and materials; or

.5 As provided in Section 7.2.5.

§ 7.2.3 Upon receipt of written confirmation of a Construction Change Directive, the Contractor shall promptly proceed with the change in the Work. An email from Owner’s Vice President, Assistant Vice President or Deputy Vice President for Capital Planning and Facilities shall constitute a written confirmation for purposes of this Section.

§ 7.2.4 A Construction Change Directive signed by the Contractor indicates the Contractor’s agreement therewith, including adjustment in Contract Sum and Contract Time or the method for determining them. Such agreement shall be effective immediately.

§ 7.2.5 Upon Agreement of the Parties, the Owner’s Representative shall determine the method and the adjustment on the basis of reasonable expenditures and savings of those performing the Work attributable to the change, including, in case of an increase in the Contract Sum, an amount for overhead and profit as set forth in the Agreement, or if no such amount is set forth in the Agreement, a reasonable amount. In such case, and also in cases where the cost adjustment is undertaken pursuant to Section 7.2.2, the Contractor shall keep and present, in such form as the Owner’s Representative may prescribe, an itemized accounting together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Section 7.2.5 shall be limited to the following:

.1 Costs of labor calculated on the Common Construction Wage set for this Project;

.2 Costs of materials, supplies and equipment, including cost of transportation, whether incorporated or consumed;

.3 Rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others.

In accordance with Section 5.3, Subcontractors shall also be required to calculate cost adjustments attributable to the change in this manner.

§ 7.2.6 The amount of credit to be allowed by the Contractor to the Owner for a deletion or change that results in a net decrease in the Contract Sum shall be actual net cost as confirmed by the Owner’s Representative plus an amount equal to ten percent (10%) of such net cost to reflect Contractor’s reduced overhead costs. When both additions and credits covering related Work or substitutions are involved in a change, the allowance for overhead and profit shall be figured on the basis of net increase, if any, with respect to that change.

§ 7.2.7 The Owner shall not be obligated to make any partial payment until a Construction Change Directive has been fully executed.

§ 7.2.8 The amount of credit to be allowed by the Contractor to the Owner for a deletion or change that results in a net decrease in the Contract Sum shall be actual net cost as confirmed by the Owner’s Representative. When both additions and credits covering related Work or substitutions are involved in a change, the allowance for overhead and profit shall be figured on the basis of net increase, if any, with respect to that change.
§ 7.3 Minor Changes in the Work
The Owner’s Representative has authority to order minor changes in the Work not involving adjustment in the Contract Sum or extension of the Contract Time and not inconsistent with the intent of the Contract Documents. Such changes will be effected by written order issued by the Owner’s Representative and through the Construction Manager and shall be binding on the Owner and Contractor. The Contractor shall carry out such written orders promptly.

§ 7.4 AGREED OVERHEAD AND PROFIT RATE
§ 7.4.1 For any adjustments in the Contract Sum, Contractor shall receive as payment for overhead and profit only the following percentages of costs attributable to the change in the work:

1. Costs of the labor payroll, set for this project as of the Notice to Proceed (base wage, plus fringe benefits), not to exceed the Common Construction Wage set for this Project/region, plus twenty-five percent (25%) of the cost of the labor payroll; plus Costs of the material, including rentals, plus ten percent (10%) of the material cost.

2. For Work by Subcontractors, or by a lower tier Contractor with Owner’s consent, the Contractor performing the Work shall be permitted to mark up its costs in accordance with Section 7.4.1.1 and each succeeding Contractor, including the Prime Contractor, shall add five percent (5%).

§ 7.4.2 When specifically authorized by the Owner and not as an Extraordinary Measure, overtime shall be paid by Owner on the basis of premium costs only, plus the cost of insurance and taxes based on the premium cost. Overhead and profit will not be paid by the Owner for overtime.

ARTICLE 8 TIME
§ 8.1 Definitions
§ 8.1.1 Unless otherwise provided, Contract Time is the period of time, including authorized adjustments, allotted in the Contract Documents for Substantial Completion of the Work.

§ 8.1.2 The date of commencement of the Work shall be no later than thirteen (13) calendar days after the date of the Notice to Proceed; provided, however, that Contractor cannot be on the Project site until the insurance requirements set forth in Article 11 and Section 9 of the Supplementary Conditions are met. No extension of time or adjustment to the Completion Date shall be allowed based on Contractor’s failure to comply with Article 11 and Section 9 of the Supplementary Conditions.

§ 8.1.3 The date of Substantial Completion is the date certified by the Owner’s Representative in accordance with Section 9.8.

§ 8.1.4 The term “day” as used in the Contract Documents shall mean calendar day unless otherwise specifically defined.

§ 8.2 Progress and Completion
§ 8.2.1 Time limits stated in the Contract Documents are of the essence of the Contract. By executing the Agreement, the Contractor confirms that the Contract Time is a reasonable period for performing the Work.

§ 8.2.2 Except by written agreement or written instruction of the Owner, Contractor shall not commence operation on the site or elsewhere prior to the commencement date of the effective date of insurance required by Article 11. The date of commencement of the Work shall not be changed by the effective date of such insurance.

§ 8.2.3 Upon receipt of a written Notice to Proceed, the Contractor shall proceed expeditiously with adequate forces and shall achieve Substantial Completion within the Contract Time.

§ 8.2.4 The number of days for Project duration as stated in the Contractor’s bid shall be noted in the Notice to Proceed and shall be used to calculate the Completion Date on the initial Project Schedule. The Completion Date shall not thereafter be changed except by way of a Construction Change Directive in accordance with Article 7.
§ 8.3 Delays and Extensions of Time
§ 8.3.1 Claims relating to time shall be made in accordance with applicable provisions of Article 15.

§ 8.3.2 If the Contractor is delayed at any time in the commencement or progress of the Work by a wrongful act or neglect of the Owner, Construction Manager or Owner’s Representative, or an employee of either, or of a separate contractor employed by the Owner, or by changes ordered in the Work or by labor disputes not caused by wrongful or unlawful acts of Contractor, fire, unusual delay in deliveries, unavoidable casualties or other causes beyond the Contractor’s reasonable control, or by delay authorized by the Owner, or by such other causes which Owner’s Representative determines may justify delay (“Excusable Delay”), then the Contract Time shall be extended for a number of days equal to the duration of the Excusable Delay, provided the Work is not, was not, or would not have been delayed by a cause for which the Contractor is responsible (“Concurrent Delay”). Extensions of the Contract Time will be permitted only to the extent that the duration of the Excusable Delay could not have been limited, avoided or mitigated.

§ 8.3.3 Except as provided in Sections 3.7.4 and 10.3.3., An extension of time for Excusable Delay, as defined above, shall be the Contractor’s exclusive remedy in the event of such a delay, no matter how or by whom caused. Contractor further specifically acknowledges that it shall have no claim for increase in contract price or damages because of any delays whatsoever to all or any part of the Work whether foreseen or unforeseen, and whether caused by any person’s hindrance or active interference.

§ 8.3.4 Acceleration: In the event of an Excusable Delay which extends Schedule Completion Dates, the Owner, in its sole discretion, in lieu of granting an enlargement of the Contract Time, may direct Contractor to accelerate its performance to meet the Construction Schedule, in which case the Owner shall direct the Owner’s Representative to issue a Construction Change Directive to increase the Contract Sum to include the additional costs of the Work, if any, reasonably incurred by Contractor to meet the Construction Schedule. Upon request, Contractor shall provide Owner with the options available for acceleration, including the costs and impact on the Construction Schedule. In presenting such costs, Contractor shall credit Owner for those costs which would not be incurred as the result of the Owner's willingness to invest extra funds to compress the Construction Schedule. Owner shall be responsible only for the actual premium costs of acceleration specifically authorized in advance for critical activity in order to offset an Excused Delay. Owner shall not be responsible for premium costs which do not accelerate critical path activities.

§ 8.4 BENEFICIAL OCCUPANCY
§ 8.4.1 The Owner shall have the privilege of Beneficial Occupancy and the use and benefit of designated areas, subdivisions or portions of the Work prior to completion and acceptance of the entire Work, provided that, in the opinion of the Owner’s Representative, such occupancy shall not unduly interfere with the Contractor's operations or unduly delay it in completing the entire Work. Such occupancy and use shall be further subject to the provisions as set forth herein.

§ 8.4.2 In the event that the Owner desires to exercise the privilege of Beneficial Occupancy, it shall give reasonable notice to the Owner’s Representative, Construction Manager and Contractor. If the Owner’s Representative and Construction Manager determine that such proposed Beneficial Occupancy is reasonable and proper, the Contractor shall cooperate with the Owner in providing basic services and facilities reasonably required for the health, safety and comfort of the occupants and other parties lawfully present and/or entering or leaving the premises. Mutually acceptable arrangements shall be made between the Owner and the Contractor with regard to procedures, terms and conditions governing the operation and maintenance of such services and facilities as may be utilized for the benefit of the Owner, in accordance with Section 4 of the Supplementary Conditions, including but not limited to the provision of Operation and Maintenance manuals. The Owner will assume proportionate and reasonable responsibility for operation of systems, equipment and/or utilities required to provide such services, in part or in total, including proportionate and reasonable expenses of operation incidental thereto.

§ 8.4.3 The Owner's occupancy or use of such designated areas, subdivisions, or portions of the Work shall not constitute acceptance of systems, materials, or elements of the Work which are not in accordance with the requirements of the Contract Documents; nor relieve the Contractor from its obligations to complete the Work; nor for responsibility for loss or damage due to or arising out of defects in, or malfunctioning of, systems, materials, equipment, or elements of the Work; nor from other unfulfilled obligations or responsibilities of the Contractor under the Contract. If, however damage results from any act of the Owner, the Owner will assume its proportionate responsibility for such damage.
§ 8.4.4 Notwithstanding the Owner’s occupancy or use of such designated areas, subdivisions, or portions of the Work pursuant to this Article, the warranty period(s) referenced in Section 3.5 shall not begin to run until Substantial Completion and Owner will continue to hold retainage in accordance with Section 9.4.4 until Substantial Completion.

ARTICLE 9 PAYMENTS AND COMPLETION

§ 9.1 Contract Sum
The Contract Sum is stated in the Agreement and, including authorized adjustments, is the total amount payable by the Owner to the Contractor for performance of the Work under the Contract Documents.

§ 9.2 Schedule of Values
Where the Contract is based on a Stipulated Sum or Guaranteed Maximum Price, the Contractor shall submit to the Construction Manager, before the first Application for Payment, a schedule of values allocating the entire Contract Sum to the various portions of the Work and prepared in such form and supported by such data to substantiate its accuracy as the Construction Manager and Owner’s Representative may require. This schedule, unless objected to by the Construction Manager or Owner’s Representative, shall be used as a basis for reviewing the Contractor’s Applications for Payment. In the event there is one Contractor, the Construction Manager shall forward to the Owner’s Representative the Contractor’s schedule of values. If there are separate contractors responsible for performing different portions of the Project, the Construction Manager shall forward the separate contractors’ schedules of values only if requested by the Owner’s Representative.

§ 9.2.1 When O&M and As Built Drawings are required, they shall be listed as a separate item in the Schedule of Values with a value of 3% of Contract Sum.

§ 9.3 Applications for Payment
§ 9.3.1 At least fifteen days before the date established for each progress payment, the Contractor shall submit to the Construction Manager an itemized Application for Payment prepared in accordance with the schedule of values, if required under Section 9.2, for completed portions of the Work. Such application shall be notarized, if required, and supported by such data substantiating the Contractor’s right to payment as the Owner, Construction Manager or Owner’s Representative may require, such as copies of requisitions from Subcontractors and material suppliers, and shall reflect retainage if provided for in the Contract Documents.

§ 9.3.1.1 As provided in Section 7.3.9, such applications may include requests for payment on account of changes in the Work that have been properly authorized by Construction Change Directives, or by interim determinations of the Owner’s Representative, but not yet included in Construction Change Directives.

§ 9.3.1.2 Applications for Payment shall not include requests for payment for portions of the Work for which the Contractor does not intend to pay a Subcontractor or material supplier unless such Work has been performed by others whom the Contractor intends to pay.

§ 9.3.2 Unless otherwise provided in the Contract Documents, payments shall be made on account of materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work. If approved in advance by the Owner, payment may similarly be made for materials and equipment suitably stored off the site at a location agreed upon in writing. Payment for materials and equipment stored off-site shall be conditioned upon compliance by the Contractor with procedures satisfactory to the Owner to establish the Owner’s title to such materials and equipment or otherwise protect the Owner’s interest, and shall include the costs of applicable insurance, storage and transportation to the site for such materials and equipment stored off the site.

§ 9.3.3 The Contractor warrants that title to all Work covered by an Application for Payment will pass to the Owner no later than the time of payment. The Contractor further warrants that upon submittal of an Application for Payment all Work for which Certificates for Payment have been previously issued and payments received from the Owner shall, to the best of the Contractor’s knowledge, information and belief, be free and clear of liens, claims, security interests or encumbrances in favor of the Contractor, Subcontractors, material suppliers, or other persons or entities making a claim by reason of having provided labor, materials and equipment relating to the Work.

§ 9.3.4 The Contractor’s Application for Payment will include the MBE/WBD Tier II Reporting as required by Supplementary Conditions, Section 8.
§ 9.4 Certificates for Payment

§ 9.4.1 The Construction Manager will, within seven days after the Construction Manager’s receipt of the Contractor’s Application for Payment, review the Application, certify the amount the Construction Manager determines is due the Contractor, and forward the Contractor’s Application and Certificate for Payment to the Owner’s Representative. Within seven days after the Owner’s Representative receives the Contractor’s Application for Payment from the Construction Manager, the Owner’s Representative will either issue to the Owner a Certificate for Payment, with a copy to the Construction Manager, for such amount as the Owner’s Representative determines is properly due, or notify the Construction Manager and Owner in writing of the Owner’s Representative’s reasons for withholding certification in whole or in part as provided in Section 9.5.1. The Construction Manager will promptly forward to the Contractor the Owner’s Representative’s notice of withholding certification.

§ 9.4.2 The issuance of a Certificate for Payment will constitute a representation by the Owner’s Representative to the Owner, based on the Owner’s Representative’s evaluation of the Work and the data comprising the Application for Payment, that, to the best of the Owner’s Representative’s knowledge, information and belief, the Work has progressed to the point indicated and that the quality of the Work is in accordance with the Contract Documents. The foregoing representations are subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial Completion, to results of subsequent tests and inspections, to correction of minor deviations from the Contract Documents prior to completion and to specific qualifications expressed by the Owner’s Representative. The issuance of a Certificate for Payment will further constitute a representation that the Contractor is entitled to payment in the amount certified. However, the issuance of a Certificate for Payment will not be a representation that the Owner’s Representative has (1) made exhaustive or continuous on-site inspections to check the quality or quantity of the Work, (2) reviewed construction means, methods, techniques, sequences or procedures, (3) reviewed copies of requisitions received from Subcontractors and material suppliers and other data requested by the Owner to substantiate the Contractor’s right to payment, or (4) made examination to ascertain how or for what purpose the Contractor has used money previously paid on account of the Contract Sum.

§ 9.4.3 Certificate for Payment shall be issued monthly provided the work is processed diligently and to the satisfaction of the Construction Manager and Owner’s Representative and Owner and shall be in the amount 5% less than the value of the work completed and materials appropriately stored on the site to the date of application of the Certificate. If, upon Substantial Completion of the Work, there are any remaining uncompleted minor items and/or Punch List items, the Owner shall be entitled to retain up to two hundred percent (200%) of the dollar value of such items until those items are completed. In addition, Owner shall be entitled to retain up to one hundred percent (100%) of any unresolved claims against the project until Owner has received written notification that all claims have been resolved. Owner shall release all retainage after all items are complete and all claims are resolved.

§ 9.4.4 At the time that the Owner withholds retainage, it shall place such retainage in an escrow account, with a bank, savings and loan institution, or the State of Indiana or an instrumentality thereof to be selected by mutual agreement between the Owner and the Contractor, as escrow agent, pursuant to a written agreement which shall provide that: (1) the escrow agent shall promptly invest all escrowed principal in such obligations as shall be selected by the escrow agent in its discretion; (2) the escrow agent shall hold the escrowed principal and income until receipt of notice from the Owner and the Contractor, specifying the portion or portions of the escrowed principal to be released from the escrow account, and the person or persons to whom such portion or portions are to be released and, upon receipt of such notice, the escrow agent shall promptly remit the designated portion of escrowed principal and the same proportion of then escrowed income to such person or persons; and (3) the escrow agent shall be compensated for its services as the parties may agree upon a commercially reasonable fee commensurate with fees then being charged for the handling of escrow accounts of like size and duration, which fee shall be paid from the escrowed income of the escrow account.

§ 9.4.5 The Owner’s Representative’s issuance of a Certificate for Payment, Project Application and Certificate for Payment, shall be based upon the Owner’s Representative’s evaluation of the Work, the certification of the Construction Manager, and information provided as part of the Application for Payment or Project Application for Payment. The Owner’s Representative’s certification will constitute a representation that, to the best of the Owner’s Representative’s knowledge, information and belief, the Work has progressed to the point indicated, that the quality of the Work is in accordance with the Contract Documents, and that the Contractor is entitled to payment in the amount certified.

§ 9.4.6 The representations made pursuant to Sections 9.4.4 and 9.4.5 are subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial Completion, to results of subsequent tests and inspections, to correction of minor deviations from the Contract Documents, to results of subsequent tests and inspections, to correction of minor deviations from the Contract Documents prior to completion and to specific qualifications expressed by the Owner’s Representative. The issuance of a Certificate for Payment will further constitute a representation that the Contractor is entitled to payment in the amount certified. However, the issuance of a Certificate for Payment will not be a representation that the Owner’s Representative has (1) made exhaustive or continuous on-site inspections to check the quality or quantity of the Work, (2) reviewed construction means, methods, techniques, sequences or procedures, (3) reviewed copies of requisitions received from Subcontractors and material suppliers and other data requested by the Owner to substantiate the Contractor’s right to payment, or (4) made examination to ascertain how or for what purpose the Contractor has used money previously paid on account of the Contract Sum.
inspections, to correction of minor deviations from the Contract Documents prior to completion and to specific qualifications expressed by the Construction Manager or Owner’s Representative.

§ 9.5 Decisions to Withhold Certification

§ 9.5.1 The Owner’s Representative may withhold a Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the Owner, if in the Owner’s Representative’s opinion the representations to the Owner required by Section 9.4.2 cannot be made. If the Owner’s Representative is unable to certify payment in the amount of the Application, the Owner’s Representative will notify the Contractor and Owner as provided in Section 9.4.1. If the Contractor and Owner’s Representative cannot agree on a revised amount, the Owner’s Representative will promptly issue a Certificate for Payment for the amount for which the Owner’s Representative is able to make such representations to the Owner. The Owner’s Representative may also withhold a Certificate for Payment or, because of subsequently discovered evidence, may nullify the whole or a part of a Certificate for Payment previously issued or the Owner may withhold payment, to such extent as may be necessary in the Owner’s Representative’s opinion to protect the Owner from loss for which the Contractor is responsible, including loss resulting from acts or omissions described in §3.3.2, because of:

1. defective Work not remedied;
2. third party claim filed or reasonable evidence indicating probable filing of such claims unless security acceptable to the Owner is provided to the Contractor;
3. failure of the Contractor to make payments properly to Subcontractors for labor, materials or equipment;
4. reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
5. damage to the Owner or another Contractor in the event that this is a multi-prime Project;
6. reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover the Owner’s damages for the anticipated delay;
7. failure to carry out the Work in accordance with the Contract Documents;
8. failure to comply with obligations regarding schedule and coordination under §3.3.1.1 or testing under Section 13.5.6;
9. rejection of the Work or any part thereof by any governmental authority having jurisdiction over the Project; or
10. failure to defend, indemnify or hold harmless the Owner, Construction Manager and the Owner’s Representative and other required indemnitees as required by the Contract Documents.

§ 9.5.2 When the above reasons for withholding certification are removed, certification will be made for amounts previously withheld. The Owner shall not be in default by reason of withholding payment while any of the grounds set forth in §9.5.1 remain uncured.

§ 9.5.3 If the Owner’s Representative or Construction Manager withholds certification for payment under Section 9.5.1.3, the Owner may, at its sole option, issue joint checks to the Contractor and to any Subcontractor or material or equipment suppliers to whom the Contractor failed to make payment for Work properly performed or material or equipment suitably delivered. If the Owner makes payments by joint check, the Owner shall notify the Owner’s Representative and the Construction Manager and both will reflect such payment on the next Certificate for Payment.

§ 9.5.4 If Contractor disputes the determination with respect to any Application for Payment, it shall make a Claim as provided in Article 15 and shall nevertheless continue to diligently prosecute the Work.
§ 9.6 Progress Payments

§ 9.6.1 After the Owner’s Representative has issued a Certificate for Payment, the Owner shall make payment in the manner and within the time provided in the Contract Documents, and shall so notify the Construction Manager and Owner’s Representative.

§ 9.6.2 The Contractor shall pay each Subcontractor, no later than seven days after receipt of payment from the Owner the amount to which the Subcontractor is entitled, reflecting percentages actually retained from payments to the Contractor on account of the Subcontractor’s portion of the Work. The Contractor shall, by appropriate agreement with each Subcontractor, require each Subcontractor to make payments to Sub-subcontractors in a similar manner.

§ 9.6.3 The Construction Manager will, on request, furnish to a Subcontractor, if practicable, information regarding percentages of completion or amounts applied for by the Contractor and action taken thereon by the Owner, Construction Manager and Owner’s Representative on account of portions of the Work done by such Subcontractor.

§ 9.6.4 The Owner has the right to request written evidence from the Contractor that the Contractor has properly paid Subcontractors and material and equipment suppliers amounts paid by the Owner to the Contractor for subcontracted Work. If the Contractor fails to furnish such evidence within seven days, the Owner shall have the right to contact Subcontractors to ascertain whether they have been properly paid. Neither the Owner, Construction Manager nor Owner’s Representative shall have an obligation to pay or to see to the payment of money to a Subcontractor except as may otherwise be required by law.

§ 9.6.5 Contractor payments to material and equipment suppliers shall be treated in a manner similar to that provided in Sections 9.6.2, 9.6.3 and 9.6.4.

§ 9.6.6 A Certificate for Payment, a progress payment, or partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.

§ 9.7 Failure of Payment

§ 9.7.1 A final Certificate of Payment shall not be issued until all labor and materials required in the Contract Documents have been furnished, installed and completed, all claims have been disposed of and all claims for extra work materials and allowances for omissions have been rendered, considered, and, if agreed to, made a part of such Certificate of Payment.

§ 9.7.2 If, pursuant to the Contract Documents, the Owner is entitled to any reimbursement or payment from the Contractor, Contractor shall make such payment within ten (10) days of demand by the Owner. Notwithstanding anything in the Contract Documents to the contrary, if Contractor fails to timely make any payment due the Owner, or if the Owner incurs any costs and expenses to cure any default of Contractor or to correct defective Work, the Owner shall have the right to either (i) deduct an amount equal to that which the Owner is entitled from any payment then or thereafter due Contractor from the Owner, or (ii) issue a written notice to the Contractor reducing the Contract Sum by an amount equal to that which the Owner is entitled.

§ 9.8 Substantial Completion

§ 9.8.1 Substantial Completion is the stage in the progress of the Work: (i) when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended use, and (ii) the Owner has received from any governmental authority having jurisdiction thereof all certificates of occupancy and all other permits, approvals, licenses, or other documents necessary for Owner’s beneficial occupancy of the Project, and (iii) Contractor submits Operating and Maintenance Manuals, As-Built Field Data Set Scans, and Interim Record Drawings.

§ 9.8.2 When the Contractor considers that the Work, or a portion thereof which the Owner agrees to accept separately, is substantially complete, the Contractor shall notify the Construction Manager, and the Contractor and Construction Manager shall jointly prepare and submit to the Owner’s Representative a comprehensive list of items to be completed or corrected prior to final payment (“punch list”). Failure to include an item of the punch list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents. Additional preconditions for the Substantial Completion inspection are set forth in the Supplementary Conditions, Section 10.
§ 9.8.3 Upon receipt of the Contractor’s punch list and the other documentation required by Supplementary Conditions, Section 10, the Owner’s Representative, assisted by the Construction Manager, will make an inspection to determine whether the Work or designated portion thereof is substantially complete. If this inspection discloses any item, whether or not included on the Contractor’s punch list, which is not sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work or designated portion thereof for its intended use, the Contractor shall, before issuance of the Certificate of Substantial Completion, as defined below, complete or correct such item upon notification by the Owner’s Representative. In such case, the Contractor shall then submit a request for another inspection by the Owner’s Representative, assisted by the Construction Manager, to determine Substantial Completion.

§ 9.8.4 When the Work or designated portion thereof is substantially complete, the Owner’s Representative will prepare an AIA Form – G704 Certificate of Substantial Completion in its then-current form (the “Certificate of Substantial Completion”) that shall establish the date of Substantial Completion, shall establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance, and shall fix the time within which the Contractor shall finish all items on the list accompanying the Certificate. Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion.

§ 9.8.5 The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in such Certificate. Upon such acceptance and consent of surety, if any, the Owner shall make payment of retainage applying to such Work or designated portion thereof. Such payment shall be adjusted for Work that is incomplete or not in accordance with the requirements of the Contract Documents.

§ 9.8.6 Operating & Maintenance Manuals and As-Built Field Data Set Scans, to the extent and in such form as may be designated by the Owner, shall be submitted to the Owner at Substantial Completion.

§ 9.9 Final Completion and Final Payment

§ 9.9.1 Upon completion of the Work, the Contractor shall forward to the Construction Manager a written notice that the Work is ready for final inspection and acceptance and shall also forward to the Construction Manager a final Contractor’s Application for Payment. Upon receipt, the Construction Manager will evaluate the completion of Work of the Contractor and then forward the notice and Application, with the Construction Manager’s certification, to the Owner’s Representative who will promptly make such inspection. When the Owner’s Representative, finds the Work acceptable under the Contract Documents and the Contract fully performed, the Construction Manager and Owner’s Representative will promptly issue a final Certificate for Payment or Project Certificate for Payment stating that to the best of their knowledge, information and belief, and on the basis of their on-site visits and inspections, the Work has been completed in accordance with terms and conditions of the Contract Documents and that the entire balance found to be due the Contractor and noted in the final Certificate is due and payable. The Construction Manager’s and Owner’s Representative’s final Certificate for Payment or Project Certificate for Payment will constitute a further representation that conditions listed in Section 9.10.2 as precedent to the Contractor’s being entitled to final payment have been fulfilled.

§ 9.9.2 No less than fourteen (14) days prior to Substantial Completion, Contractor shall submit the following to the Owner’s Representative

1. an affidavit that all payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or the Owner’s property might be responsible or encumbered (less amounts withheld by Owner) have been paid or otherwise satisfied;

2. a certificate evidencing that insurance required by the Contracts Documents to remain in force after final payment is currently in effect, will remain in effect through the end of the warranty period, and will not be canceled or allowed to expire until at least 30 days’ prior written notice has been given to the Owner;

3. a written statement that the Contractor knows of no substantial reason that the insurance will not be renewable to cover the period required by the Contract Documents;

4. consent of surety, if any, to final payment;
5. the Owner’s properly executed asbestos containing materials (ACM) certification form (included in front end documentation or available through Owner’s Environmental Health & Safety Office);

6. if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts, releases and waivers of liens, claims, security interests or encumbrances arising out of the Contract. If a Subcontractor refuses to furnish a release or waiver required by the Owner, the Contractor may furnish a bond satisfactory to the Owner to indemnify the Owner against such lien or claim. If such lien or claim remains unsatisfied after payments are made, the Contractor shall refund to the Owner all money that the Owner may be compelled to pay in discharging such lien or claim, including all costs and reasonable attorneys’ fees;

7. COBIE to the extent and in such form as may be designated by the Owner;

8. Lock-Out/Tag-Out Manuals as required in the Project Specifications;

9. those documents required in Supplementary Conditions, Section 10.

Neither final payment nor any remaining retained percentage shall become due until these submissions are made by Contractor.

§ 9.9.2.1 Contractor shall provide a Final Waiver of Lien (one copy to Owner and one copy to Owner’s Representative as a condition to receiving Final Payment.

§ 9.9.2.2 The final Certificate for Payment shall constitute the acceptance of the Work by the Owner, except as to Work thereafter found to be defective. The date of such Certificate shall be regarded as the date of acceptance of the Work, and payment of the retained percentage shall be due sixty-one (61) days from the date of acceptance, providing that the Contractor has furnished written documentation that all claims filed with the Owner from subcontractors and materials suppliers have been resolved.

§ 9.9.3 If, after Substantial Completion of the Work, final completion thereof is materially delayed through no fault of the Contractor or by issuance of Construction Change Directives affecting final completion, and the Construction Manager and Owner’s Representative so confirm, the Owner shall, upon application by the Contractor and certification by the Construction Manager and Owner’s Representative, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed and accepted. If the remaining balance for Work not fully completed or corrected is less than retainage stipulated in the Contract Documents, and if bonds have been furnished, the written consent of surety to payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by the Contractor to the Owner’s Representative through the Construction Manager prior to certification of such payment. Such payment shall be made under terms and conditions governing final payment, except that it shall not constitute a waiver of Claims.

§ 9.9.4 The making of final payment shall constitute a waiver of Claims by the Owner except those arising from

1. liens, Claims, security interests or encumbrances arising out of the Contract and unsettled;

2. failure of the Work to comply with the requirements of the Contract Documents; or

3. terms of special warranties required by the Contract Documents.

§ 9.9.5 Acceptance of final payment by the Contractor, a Subcontractor or material supplier shall constitute a waiver of claims by that payee except those previously made in writing and identified by that payee as unsettled at the time of final Application for Payment.

ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY

§ 10.1 Safety Precautions and Programs

§ 10.1 HEALTH AND SAFETY PRECAUTIONS AND PROGRAMS

The Contractor shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the performance of the Contract.

§ 10.1.1 The Construction Manager shall be responsible for the oversight of the health safety programs of the Prime Contractors. Each Prime Contractor acknowledges that it remains the controlling employer as to its employees and
subcontractors and that it individually must comply with the applicable safety laws, including but not limited to (CFR 1926) the Occupational Safety and Health Administration (OSHA), Safety and Health Regulations for the Construction Industry and all General Industry standards applicable thereto. By executing the Contract, each Prime Contractor represents that it is knowledgeable with respect to such laws and will take all necessary measures to comply therewith. It is acknowledged that Owner does not possess expertise as to construction-related safety matters and programs and, therefore, Owner does not assume any duty to the Contractor, its Subcontractors or Suppliers, separate contractors or others involved with the Project as to the applicable safety standards or procedures with respect to their work or services. The Construction Manager's responsibility for review and coordination shall not extend to direct control over or charge of the acts or omissions of the Contractors, Subcontractors, Agents or employees of the contractors or subcontractors, or any other persons performing portions of the work and not directly employed by the Construction Manager.

§ 10.2 Safety of Persons and Property

§ 10.2.1 The Contractor shall take reasonable precautions for safety of, and shall provide reasonable protection to prevent damage, injury or loss to

1. employees on the Work and other persons who may be affected thereby;
2. the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody or control of the Contractor or the Contractor’s Subcontractors or Sub-subcontractors; and
3. other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation or replacement in the course of construction.

§ 10.2.2 The Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations and lawful orders of public authorities bearing on safety of persons or property or their protection from damage, injury or loss. In the event of any conflict among the Contract Documents and any federal, state or local authorities, laws, rules, regulations or requirements, the most stringent requirement shall govern the Work.

§ 10.2.2.1 If the Contractor fails to give such notices or fails to comply with such law, ordinances, rules, regulations, and unlawful orders, it shall be liable for and shall defend, indemnify and hold harmless the Owner and the Owner’s Representative and the Construction Manager and their respective employees, officers and agents, against any resulting fines, penalties, judgments or damages, including reasonable attorneys’ fees, imposed on or incurred by the parties indemnified herein.

§ 10.2.3 The Contractor shall erect and maintain, as required by existing conditions and performance of the Contract, reasonable safeguards for safety and protection, including posting danger signs and other warnings against hazards, promulgating safety regulations and notifying owners and users of adjacent sites and utilities. The Contractor also shall be responsible, at the Contractor’s sole cost and expense, for all measures necessary to protect any property adjacent to the Project and improvements thereon or therein. Any damage to such property or improvements shall be promptly and properly repaired by the Contractor.

§ 10.2.4 When use or storage of explosives or other hazardous materials or equipment or unusual methods are necessary for execution of the Work, the Contractor shall exercise utmost care and carry on such activities under supervision of properly qualified personnel.

§ 10.2.5 The Contractor shall promptly remedy damage and loss (other than damage or loss insured under property insurance required by the Contract Documents) to property referred to in Sections 10.2.1.2, 10.2.1.3 and 10.2.1.4 caused in whole or in part by the Contractor, a Subcontractor, a Sub-subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable and for which the Contractor is responsible under Sections 10.2.1.2, 10.2.1.3 and 10.2.1.4, except damage or loss attributable to acts or omissions of the Owner, Construction Manager or Owner’s Representative or anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to the Contractor’s obligations under Section 3.18.

§ 10.2.6 The Contractor shall designate a responsible member of the Contractor’s organization at the site whose duty shall be the prevention of accidents and health-related risks. This person shall be the Contractor’s superintendent...
unless otherwise designated by the Contractor in writing to the Owner, Construction Manager and Owner’s Representative.

§ 10.2.7 The Contractor shall not permit any part of the construction or site to be loaded so as to cause damage or create an unsafe condition.

§ 10.2.8 Injury or Damage to Person or Property
If either party suffers injury or damage to person or property because of an act or omission of the other party, or of others for whose acts such party is legally responsible, written notice of such injury or damage, whether or not insured, shall be given to the other party within a reasonable time not exceeding 21 days after discovery. The notice shall provide sufficient detail to enable the other party to investigate the matter.

§ 10.2.8 When all or a portion of the Work is suspended for any reason, Contractor shall securely fasten down all coverings and protect the Work from injury by any cause.

§ 10.2.9 The Contractor promptly, and in no event later than required by applicable OSHA regulations, shall report in writing to the Owner and Owner’s Representative all accidents arising out of or in connection with the Work that caused death, personal injury or property damage, giving full details and statements of any witnesses. Accidents causing death, serious personal injuries or serious property damage shall also be immediately reported by telephone or messenger to the Owner, Construction Manager and Owner’s Representative. Owner shall have the right, but not the duty, to investigate all accident reports.

§ 10.3 Hazardous Materials

§ 10.3.1 Regulated Substance Definition: "Regulated Substance" includes oil, petroleum or any fraction thereof, a hazardous substance, a hazardous waste, a waste containing a hazardous substance, a contaminant, a pollution or a regulated chemical, as any of those terms may be defined by the United States Environmental Protection Agency or in any one of the following laws: The comprehensive Environmental Response, Compensation and Liability Act 42 USC Section 9601, et seq., (CERCLA), as amended, the Resource Conservation and Recovery Act (RCRA), as amended, the Emergency Planning and Community Right to Know Act of 1986, also known as SARA Title III or EPCRA, the Toxic Substance Control Act (TSCA), as amended, the Clean Water Act, as amended, the Clean Air Act, as amended, the Federal Insecticide, Fungicide, and Rodenticide Act, as amended, the Federal Water Pollution Control Act, as amended, the Oil Pollution Act of 1990, as amended, the Safe Drinking Water Act, as amended, the Occupational Safety and Health Act as amended or another federal state or local law rule ordinance statute regulation permit or other governmental restriction regulating environmental health or safety matters.

§ 10.3.2 If Contractor encounters substances on the Project which Contractor reasonably believes to be polychlorinated biphenyls (PCBs) or regulated substances other than asbestos or asbestos-containing materials ("ACM") in a form, location or quantity that requires Contractor or the Owner to take action under applicable law, Contractor immediately shall stop the Work in the affected area and report the condition to the Owner and Owner’s Representative by telephone followed by written report. Work in the affected area shall not resume until the substance has been ruled harmless, as defined in Subparagraph 10.3.3, or until a ruling that the Work may proceed in accordance with applicable laws.

§ 10.3.3 The Owner shall obtain the services of a licensed laboratory to verify the presence or absence of the material or substance reported by the Contractor and, in the event such material or substance is found to be present, to verify that it has been rendered harmless. Unless otherwise required by the Contract Documents, the Owner shall furnish in writing to the Contractor, Construction Manager and Owner’s Representative the names and qualifications of persons or entities who are to perform tests verifying the presence or absence of such material or substance or who are to perform the task of removal or safe containment of such material or substance. The Contractor, Construction Manager and the Owner’s Representative will promptly reply to the Owner in writing stating whether or not it has reasonable objection to the persons or entities proposed by the Owner. If the Contractor, Construction Manager or Owner’s Representative has an objection to a person or entity proposed by the Owner, the Owner shall propose another to whom the Contractor, Construction Manager and the Owner’s Representative have no reasonable objection. When the material or substance has been rendered harmless, Work in the affected area shall resume upon written direction from the Owner’s Representative with a copy to the Owner and the Construction Manager. The Contract Time shall be extended appropriately and the Contract Sum shall be increased in the amount of the Contractor's reasonable additional costs of shut-down and start-up, if any, which adjustments shall be accomplished...
as provided in Article 7. “Rendered harmless” shall mean that levels of asbestos, PCBs or other regulated substances are less than any applicable exposure standards set forth in OSHA regulations. In no event, however, shall the Owner have any responsibility for any substance or material brought to the Project Site by the Contractor, any Subcontractor, any material supplier, or any entity for whom any of them is responsible. The Contractor shall not use any fill or other materials to be incorporated into the Work that are hazardous, toxic, or contaminated by any Regulated Substance.

§ 10.3.4 If the Contract Documents permit the use of a Regulated Substance of a type which by law an employer must notify its employees is to be used on the Project, then prior to exposure of any person on the Site to such Substance, Contractor shall notify the Construction Manager and Owner’s Representative in writing of the chemical composition thereof in sufficient detail and time, including, but not limited to providing a material safety data sheet for such Substance, to permit the Owner and other persons and entities to comply with any applicable laws. Contractor's activities regarding the use of any such Regulated Substance are to be coordinated with the activities of Owner and other persons or entities to avoid any cost or impact to the Owner or any other person or entity as the result of the use of such Regulated Substance.

§ 10.3.5 Contractor shall not dispose of a Regulated Substance on the Project Site. Contractor shall not commingle Regulated Substances with materials or waste of the Owner, another Prime Contractor (in the event that the Project is a multi-prime Project) or any other person or entity performing Work on the Project Site. Contractor shall provide separate disposal receptacles approved by law for the particular regulated substance(s) which will be placed in them. Such receptacles shall be used exclusively for the storage or temporary disposal of Regulated Substances for which they are approved. When storing, working with, treating or disposing of regulated substances, Contractor and its waste hauler shall strictly comply with all applicable laws. Contractor shall identify its waste haulers and provide the Owner with a copy of each manifest or other document relating to the storage, transportation or disposal of any Regulated Substance taken from the Project Site.

§ 10.3.6 If, without negligence on the part of the Contractor, the Contractor is held liable by a government agency for the cost of remediation of a hazardous material or substance solely by reason of performing Work as required by the Contract Documents, the Owner shall indemnify the Contractor for all cost and expense thereby incurred; provided, however, that Owner’s obligations under this Section shall be limited in substance by statutes and constitutional provisions designed to protect the exposure and liability of Indiana University as an instrumentality of the State of Indiana (e.g., actions and conditions as to which the Owner is immunized by the Indiana Tort Claims Act, dollar limits stated in such Act, exemption from punitive damages, the continued ability to defeat a claim by reason of contributory negligence or fault of claimant), so that its liability to indemnify, defend and hold harmless shall not exceed what might have been its liability to a claimant if sued directly in Indiana by the claimant and all appropriate defenses had been raised by the Owner.

§10.3.7 If Contractor encounters substances on the Project which Contractor reasonably believes to be asbestos or ACM, Contractor shall act in accordance with Indiana University Project Site Requirements, Section 15. B.

§10.3.8 In addition to the requirements identified in this Section, Contractor shall comply with the requirements set forth in Section 15 of the Indiana University Project Site Requirements.

§ 10.4 Emergencies
In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor’s discretion, to prevent threatened damage, injury or loss. Additional compensation or extension of time claimed by the Contractor on account of an emergency shall be determined as provided in Article 15 and Article 7.

§ 10.5 EQUAL EMPLOYMENT OPPORTUNITY AND NON-DISCRIMINATION

§ 10.5.1 The Contractor shall not discriminate against any employee or applicant for employment because of race, religion, color, sex, national origin, marital status, age, sexual orientation, veteran status or disability. The Contractor shall take affirmative action to ensure that applicants are employed and that employees are treated during employment without regard to their race, religion, color, sex, national origin, marital status, age, sexual orientation, veteran status or disability. Such action shall include, but not be limited to the following: employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous...
§ 10.5.2 The Contractor shall, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive consideration for employment without regard to race, religion, color, sex, national origin, marital status, age, sexual orientation, veteran status or disability.

§ 10.5.3 The Contractor shall send to each labor union or representative of workers with which it has a collective bargaining agreement or other contract or understanding, a notice to be provided advising the labor union or workers representative of the Contractors' commitments under Section 202 of Executive Order No. 11246 dated September 24, 1965, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

§ 10.5.4 The Contractor shall comply with all provisions of Executive Order No. 11246 dated September 24, 1965, and of the rules, regulations and relevant orders of the Secretary of Labor.

§ 10.5.5 The Contractor shall furnish all information and reports required by Executive Order No. 11246 dated September 24, 1965, and by the rules, regulations and order of the Secretary of Labor. or pursuant thereto, and will permit access to its books, records, and accounts by an appropriate agency of the federal government and by the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulation and others.

§ 10.5.6 In addition to the requirements identified in this Section, Contractor shall comply with the requirements set forth in Section 8 of the Supplementary Conditions.

ARTICLE 11 INSURANCE AND BONDS

§ 11.1 INSURANCE GENERAL

§ 11.1.1 The Contractor shall take out and maintain the insurance required in the Supplementary Conditions, Section 9 and as otherwise required in this Article 11 during the life of the Contract and until final acceptance of the work contemplated by this Contract.

§ 11.1.2 Workers' Compensation, Occupational Disease and Employer's Liability: Types and amounts of required worker's compensation insurance are set forth in the Supplementary Conditions, Section 9. The Owner reserves the right to purchase this coverage as part of a "wraparound program" and, if Owner so elects, Contractor shall not provide this coverage nor include the cost of such coverage in any bid.

§ 11.1.3 Liability Insurance: Types and amounts of required liability insurance are set forth in the Supplementary Conditions, Section 9. The Owner reserves the right to purchase coverage as part of a "wraparound program" and if Owner so elects, Contractor shall not provide this coverage or include the cost of such coverage in any bid.

It is agreed and understood that a combination of primary and excess (or umbrella) coverage to reach limits required for general liability and auto liability is acceptable.

§ 11.1.4 [intentionally omitted]

§ 11.1.5 [intentionally omitted]

§ 11.1.6 [intentionally omitted]

§ 11.1.7 In no event shall any failure of the Owner to receive certified copies or certificates of policies required under this Article, or to demand receipt of such certified copies or certificates prior to Contractor commencing the work, be construed as a waiver by the Owner or the Owner's Representative of the Contractor's obligations to obtain insurance pursuant to this Article. The obligation to procure and maintain any insurance required by this Article is a separate responsibility of the Contractor and independent of the duty to furnish the certified copy or certificate of such insurance policies.

§ 11.1.8 If Contractor fails to purchase and maintain any insurance required under this Article, the Owner may, but shall not be obligated to, upon five (5) days written notice to the Contractor, purchase such insurance on behalf of
the Contractor and deduct the cost of such insurance from any amounts due and owing to the Contractor. If amounts due and owing the Contractor are not sufficient to reimburse the Owner for the cost of such insurance, the Contractor shall reimburse the Owner for the cost of such insurance upon written demand.

§ 11.1.9 Within thirty (30) days of when any required insurance, due to the attainment of a normal expiration date or renewal date, shall expire, the Contractor shall supply the Owner with certificates of insurance and amendatory riders or endorsements that clearly evidence the continuance of all coverage in the same manner, limits of protection, and scope of coverage as was provided by the previous policy. In the event any renewal or replacement policy, for whatever reason obtained or required, is written by a carrier other than that with whom the coverage was previously placed, or the subsequent policy differs in any way from the previous policy, the Contractor shall also furnish the Owner with a certified copy of the renewal or replacement policy unless the Owner provides the Contractor with prior written consent to submit only a certificate of insurance for any such policy. All renewal and replacement policies shall be in form and substance satisfactory to the Owner and written by carriers acceptable to the Owner.

§ 11.1.10 [intentionally omitted]

§ 11.2 BUILDER’S RISK INSURANCE, ALL RISK
The Owner’s obligation to provide Builder’s Risk Insurance is identified in the Supplementary Conditions, Section 9.

§ 11.2.2 Beneficial Occupancy or use in accordance with Section 8.4 herein shall not commence until the insurance company or companies providing property insurance have consented to such Beneficial Occupancy or use by endorsement or otherwise. The Owner and the Contractor shall take reasonable steps to obtain consent of the insurance company or companies and shall not, without mutual written consent, take any action with respect to Beneficial Occupancy or use that would cause cancellation, lapse or reduction of insurance.

§ 11.2.3 [intentionally omitted]

§ 11.2.4 [intentionally omitted]

§ 11.2.5 [intentionally omitted]

§ 11.2.7 Waiver of Subrogation: Terms governing waiver of subrogation are set forth in the Supplementary Conditions, Section 9.

§ 11.2.8 A loss insured under Owner’s property insurance shall be adjusted by the Owner in good faith and made payable to the Owner as fiduciary in good faith for the insured, as their interest may appear, subject to requirements of any bonding obligations associated with the Project. The Contractor shall pay subcontractors their just share of insurance proceeds received by the Contractor, and by appropriate agreements, written where legally required for validity, shall require subcontractors to make payments to their Sub-subcontractors in similar manner.

§ 11.2.9 The Owner in good faith shall have power to adjust and settle a loss with insurers, unless one of the parties in interest shall object in writing within five (5) days after occurrence of loss to the Owners exercise of this power.

§ 11.3 PERFORMANCE AND PAYMENT BOND
§ 11.3.1 The Owner shall have the right to require the Contractor to furnish bonds covering faithful performance of the Contract and payment of obligations arising thereunder as stipulated in bidding requirements or specifically required in the Contract documents on the date of execution of the Contract, or as required by applicable law. This bond shall be furnished using the form provided to Contractor by the Owner.

§ 11.3.2 Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Contract, the Contractor shall promptly furnish a copy of the bonds or shall permit a copy to be made.
ARTICLE 12 UNCOVERING AND CORRECTION OF WORK

§ 12.1 Uncovering of Work
§ 12.1.1 If a portion of the Work is covered contrary to the Construction Manager’s or Owner Representative’s request or to requirements specifically expressed in the Contract Documents, it must, if requested in writing by either, be uncovered for their observation and be replaced at the Contractor’s expense without change in the Contract Time.

§ 12.1.2 If a portion of the Work has been covered which the Construction Manager or Owner’s Representative has not specifically requested to observe prior to its being covered, the Construction Manager or Owner’s Representative may request to see such Work and it shall be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, costs of uncovering and replacement shall, by appropriate Construction Change Directive, be at the Owner’s expense. If such Work is not in accordance with the Contract Documents, such costs and the cost of correction shall be at the Contractor’s expense unless the condition was caused by the Owner or one of the other Contractors in which event the Owner shall be responsible for payment of such costs.

§ 12.2 Correction of Work
§ 12.2.1 Before or After Substantial Completion
The Contractor shall promptly correct Work rejected by the Construction Manager or Owner’s Representative or failing to conform to the requirements of the Contract Documents, whether discovered before or after Substantial Completion and whether or not fabricated, installed or completed. Costs of correcting such rejected Work, including additional testing and inspections, the cost of uncovering and replacement, and compensation for the Construction Manager’s and Owner’s Representative’s services and expenses made necessary thereby, shall be at the Contractor’s expense. If, prior to the date of final payment, the Contractor, a Subcontractor, or anyone for whom either is responsible, uses or damages any portion of the Work, including, without limitation, mechanical, electrical, plumbing, or other building systems, machinery, equipment, or other mechanical device, Contractor shall cause such item to be restored to “like new” condition at no expense to the Owner and shall not assert a claim for delay or request a Construction Change Directive on this basis.

§ 12.2.2 After Substantial Completion
§ 12.2.2.1 In addition to the Contractor’s obligations under Section 3.5, if, within two years after the date of Substantial Completion of the Work or designated portion thereof, or after the date for commencement of warranties established under Section 9.8.4, or by terms of an applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, the Contractor shall correct it within the time provided in Paragraph 2.4 promptly after receipt of written notice from the Owner to do so unless the Owner has previously given the Contractor a written acceptance of such condition. The Owner shall give such notice as provided in Paragraph 2.4 promptly after discovery of the condition. If within thirty (30) days following the two-year period for correction of Work, the Owner fails to notify the Contractor of a defective condition other than latent defects unknown to the Owner, and give the Contractor an opportunity to make the correction, the Owner waives the rights to require correction by the Contractor and to make a claim for breach of warranty. If the Contractor fails to correct nonconforming Work within a reasonable time after receipt of notice from the Owner or Owner’s Representative, the Owner may correct it in accordance with Section 2.4.

The Contractor’s responsibility to correct such work within two years of Substantial Completion shall not be affected, diminished or restricted by the limitations, restrictions or conditions of a subcontractor, manufacturer, supplier, or installer’s warranty, including the expiration of any Uniform Commercial Code statute of limitations. The inability or refusal of a subcontractor, manufacturer, supplier or installer responsible for defective Work to correct or warrant such Work shall not relieve the Contractor from its obligation to correct such Work within two years of Substantial Completion.

§ 12.2.2.2 The two-year period for correction of Work shall be extended with respect to portions of Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual completion of that portion of the Work.

§ 12.2.2.3 Upon completion of any work under or pursuant to this Section 12.2, the two-year correction period in connection with the Work requiring correction shall be renewed and recommenced. The obligations under Paragraph 12.2 shall cover any repairs and replacements to any part of the Work or other property that is damaged by the defective Work.
§ 12.2.4 During the two-year period for correction of the Work, Contractor shall, at its own cost, repair all interior and exterior masonry or drywall cracks and provide new control joints as required.

§ 12.2.3 The Contractor shall remove from the site portions of the Work that are not in accordance with the requirements of the Contract Documents and are neither corrected by the Contractor nor accepted by the Owner.

§ 12.2.4 The Contractor shall bear the cost of correcting destroyed or damaged construction, whether completed or partially completed, of the Owner or separate contractors caused by the Contractor’s correction or removal of Work that is not in accordance with the requirements of the Contract Documents.

§ 12.2.5 Nothing contained in this Section 12.2 shall be construed to establish a period of limitation with respect to other obligations the Contractor has under the Contract Documents. Establishment of the two-year period for correction of Work as described in Section 12.2.2 relates only to the specific obligation of the Contractor to correct the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor’s liability with respect to the Contractor’s obligations other than specifically to correct the Work.

§ 12.3 Acceptance of Nonconforming Work
If the Owner prefers to accept Work that is not in accordance with the requirements of the Contract Documents, the Owner may do so instead of requiring its removal and correction, in which case the Contract Sum will be reduced as appropriate and equitable. Such adjustment shall be effected whether or not final payment has been made.

ARTICLE 13 MISCELLANEOUS PROVISIONS
§ 13.1 Governing Law
The Contract shall be governed by the laws of the State of Indiana and the sole and exclusive venue of any claims or disputes arising out of this Agreement (including counterclaims, cross-claims, third party claims and claims for indemnity) shall be Monroe County, Indiana.

§ 13.2 Successors and Assigns
§ 13.2.1 The Owner and Contractor respectively bind themselves, their partner, successors, assigns and legal representatives to the other party hereto and to partners, successors, assigns and legal representatives of such other party in respect to covenants, agreements and obligations contained in the Contract Documents. Except as provided elsewhere in the Contract Documents, the Contractor shall not assign the Contract in whole or in part, or any rights whatsoever (including the right to payment or to present or assert claims arising out of the Project) without prior written consent of the Owner. If the Contractor attempts to make such an assignment without prior written consent it shall be void and of no effect.

§ 13.3 Written Notice
Written notice shall be deemed to have been duly served if delivered in person to the individual or a member of the firm or entity or to an officer of the corporation for which it was intended; or if delivered by facsimile transmission, registered or certified mail or express carrier to persons designated in the Agreement. Email shall constitute valid notification only in those circumstances identified in Section 7.2.3.

§ 13.4 Rights and Remedies
§ 13.4.1 Duties and obligations imposed by the Contract Documents and rights and remedies available thereunder shall be in addition to and not a limitation of duties, obligations, rights and remedies otherwise imposed or available by law.

§ 13.4.2 The waiver by the Owner of any breach or default of the Contract by the Contractor shall not be construed as a waiver of any other breach or default of the same or any other terms or conditions of the Contract. Forbearance from demanding strict compliance with any term or provision of the Contract shall not operate as a waiver and shall not prevent the Owner from subsequently demanding strict compliance therewith.

§ 13.5 Tests and Inspections
§ 13.5.1 Tests, inspections and approvals of portions of the Work shall be made as required by the Contract Documents and by applicable laws, statutes, ordinances, codes, rules and regulations or lawful orders of public authorities. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections and
approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections and approvals. The Contractor shall give the Construction Manager and Owner’s Representative timely notice of when and where tests and inspections are to be made so that the Construction Manager and Owner’s Representative may be present for such procedures. The Owner shall bear costs of (1) tests, inspections or approvals that do not become requirements until after bids are received or negotiations concluded, and (2) tests, inspections or approvals where building codes or applicable laws or regulations prohibit the Owner from delegating their cost to the Contractor.

§ 13.5.2 If the Construction Manager, Owner’s Representative, Owner or public authorities having jurisdiction determine that portions of the Work require additional testing, inspection or approval not included under Section 13.5.1, the Construction Manager and Owner’s Representative will, upon written authorization from the Owner, instruct the Contractor to make arrangements for such additional testing, inspection or approval by an entity acceptable to the Owner, and the Contractor shall give timely notice to the Construction Manager and Owner’s Representative of when and where tests and inspections are to be made so that the Construction Manager and Owner’s Representative may be present for such procedures. Such costs except as provided in Section 13.5.3, shall be at the Owner’s expense.

§ 13.5.3 If such procedures for testing, inspection or approval under Sections 13.5.1 and 13.5.2 reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, all costs made necessary by such failure including those of repeated procedures and compensation for the Construction Manager’s and Owner’s Representative’s services and expenses shall be at the Contractor’s expense.

§ 13.5.4 Required certificates of testing, inspection or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor and promptly delivered to the Construction Manager for transmittal to the Owner’s Representative.

§ 13.5.5 If the Construction Manager or Owner’s Representative are to observe tests, inspections or approvals required by the Contract Documents, the Construction Manager or Owner’s Representative will do so promptly and, where practicable, at the normal place of testing.

§ 13.5.6 Tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work.

§ 13.5.7 The Owner reserves the right to allocate, reallocate or modify the scope of any of the testing and inspection services specified in the Contract Documents to be performed by a testing laboratory, testing agency or consultant retained by the Owner in connection with the Work if such adjustment and scope is consistent with the intent of the Contract Documents. In the event that the Contractor does not concur with such modification of scope or reallocation of such services, Contractor shall immediately notify the Construction Manager, Owner’s Representative and Owner in writing.

§ 13.6 TIME LIMITS ON CLAIMS
The Owner and Contractor shall commence all claims and causes of action, whether in contract, tort, breach of warranty or otherwise, against the other arising out of or related to the Contract in accordance with the requirements of the final dispute resolution method selected in the Agreement within the time period specified by applicable law, but in any case not more than 10 years after the date of Substantial Completion of the Work. The Owner and Contractor waive all claims and causes of action not commenced in accordance with this Section 13.6.

§ 13.7 INTERPRETATION
All personal pronouns used in the Contract Documents, whether used in the masculine, feminine or neuter gender shall include all other genders; and the singular shall include the plural and vice versa. Titles of articles, paragraphs, and subparagraphs are for convenience only and neither limit nor amplify the provisions of such articles, paragraphs and subparagraphs.

§ 13.8 SEVERABILITY
Whenever possible, each provision of the Contract Documents shall be interpreted in a manner to be effective and valid under applicable law. If, however, any provision of the Contract Documents, or a portion thereof, is prohibited by law or found invalid under a new law, only such provision or portion thereof shall be ineffective, without any
manner invalidating or affecting the remaining portions of the Contract Documents or valid portions of such provision, which are hereby deemed severable.

§ 13.9 FUTURE COOPERATION
Each party hereto agrees to do all acts and things and to make, execute and deliver such written instruments, as from time to time shall be reasonably required to carry out the terms and provisions of the Contract Documents.

ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT
§ 14.1 Termination by the Contractor
§ 14.1.1 The Contractor may terminate the Contract if the Work is stopped for a period of 30 consecutive days through no act or fault of the Contractor or a Subcontractor, Sub-subcontractor or their agents or employees or any other persons or entities performing portions of the Work under direct or indirect contract with the Contractor, for any of the following reasons:

  .1 Issuance of an order of a court or other public authority having jurisdiction that requires all Work to be stopped;

  .2 An act of government, such as a declaration of national emergency that requires all Work to be stopped;

  .3 Because the Construction Manager has not certified or the Owner’s Representative has not issued a Certificate for Payment and has not notified the Contractor of the reason for withholding certification as provided in Section 9.4, or because the Owner has not made payment on a Certificate for Payment within the time stated in the Contract Documents; or

§ 14.1.2 If one of the reasons described in Section 14.1.1 exists, the Contractor may, upon seven days’ written notice to the Owner, Construction Manager and Owner’s Representative, terminate the Contract and recover from the Owner payment for Work executed, including reasonable overhead and profit, costs incurred by reason of such termination, and damages.

§ 14.2 Termination by the Owner for Cause
§ 14.2.1 The Owner may terminate the Contract if the Contractor

  .1 repeatedly refuses or fails to supply enough properly skilled workers or proper materials;

  .2 fails to make payment to Subcontractors for materials or labor in accordance with the respective agreements between the Contractor and the Subcontractors;

  .3 repeatedly disregards applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of a public authority; or

  .4 otherwise is guilty of substantial breach of a provision of the Contract Documents.

§ 14.2.2 When any of the above reasons exist, the Owner, after consultation with the Construction Manager, and upon certification by the Owner’s Representative that sufficient cause exists to justify such action, may without prejudice to any other rights or remedies of the Owner and after giving the Contractor and the Contractor’s surety, if any, seven days’ written notice, terminate employment of the Contractor and may, subject to any prior rights of the surety:

  .1 Exclude the Contractor from the site and take possession of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;

  .2 Accept assignment of subcontracts pursuant to Section 5.4; and

  .3 Finish the Work by whatever reasonable method the Owner may deem expedient. Upon written request of the Contractor, the Owner shall furnish to the Contractor a detailed accounting of the costs incurred by the Owner in finishing the Work.

§ 14.2.3 When the Owner terminates the Contract for one of the reasons stated in Section 14.2.1, the Contractor shall not be entitled to receive further payment until all claims and disputes are resolved.

§ 14.2.4 If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, including compensation for the Construction Manager’s and Owner’s Representative’s services and expenses made necessary thereby, and other damages incurred by the Owner and not expressly waived, such excess shall be paid to the Contractor. If such costs and damages exceed the unpaid balance, the Contractor shall pay the difference to the Owner. The amount to be paid to the Contractor or Owner, as the case may be, shall, upon application, be certified by the Owner’s Representative after consultation with the Construction Manager, and this obligation for payment shall survive termination of the Contract.
§ 14.3 Suspension by the Owner for Convenience
§ 14.3.1 The Owner may, without cause, order the Contractor in writing to suspend, delay or interrupt the Work in whole or in part for such period of time as the Owner may determine.

§ 14.4 Termination by the Owner for Convenience
§ 14.4.1 The Owner may, at any time, terminate the Contract for the Owner’s convenience and without cause.

§ 14.4.2 Upon receipt of written notice from the Owner of such termination for the Owner’s convenience, the Contractor shall

1. cease operations as directed by the Owner in the notice;
2. take actions necessary, or that the Owner may direct, for the protection and preservation of the Work; and
3. except for Work directed to be performed prior to the effective date of termination stated in the notice, terminate all existing subcontracts and purchase orders and enter into no further subcontracts and purchase orders.

§ 14.4.3 Upon such termination, the Contractor shall recover as its sole remedy payment for Work properly performed prior to the effective date of termination and for items properly and timely fabricated off the Project Site, delivered and stored in accordance with the Owner’s instructions plus profit and overhead on the foregoing items not previously paid. Contractor hereby waives and forfeits all other claims for payment and damages, including, without limitation, anticipated profits. The Owner shall be credited for (i) payments previously made to Contractor for the terminated portion of the Work, (ii) claims that the Owner has against the Contractor under the Contract and (iii) the value of the materials, supplies, equipment, or other terms that are to be disposed of by the Contractor that are part of the Contract Sum.

§ 14.5 SURVIVAL OF WARRANTIES
All warranties made to the Owner by Contractor, and all obligations of Contractor to defend, indemnify, and hold harmless the Owner, shall survive any termination of the employment of Contractor for any reason.

ARTICLE 15 CLAIMS AND DISPUTES
§ 15.1 Claims
§ 15.1.1 Definition. A Claim is a demand or assertion by one of the parties seeking, as a matter of right, adjustment or interpretation of the Contract terms, payment of money, extension of time or other relief with respect to the terms of the Contract. The term ‘Claim’ also includes other disputes and matters in question between the Owner and Contractor arising out of or relating to the Contract. The responsibility to substantiate Claims shall rest with the party making the Claim.

§ 15.1.2 Notice of Claims. Claims by either the Owner or Contractor must be initiated by written notice to the other party and to the Owner’s Representative with a copy to the Construction Manager. Claims by either party must be initiated within 7 days after occurrence of the event giving rise to such Claim or within 7 days after the claimant first recognizes the condition giving rise to the Claim, whichever is later. Once a Claim is recognized, the claimant shall use its best efforts to give the Owner’s Representative and the other party notice of any such Claim as expeditiously as possible, including, without limitation, Claims in connection with concealed or unknown conditions. Claimant shall cooperate with the Owner’s Representative, Construction Manager and the party against whom the Claim is made in any reasonable effort to mitigate alleged or potential damages, delays or other adverse consequences arising out of the condition that is the subject of such Claim. Unless the other party objects, Claims may be reserved in the claimant that will require the other party a copy of the notice from the claimant is received by the Owner’s Representative and Construction Manger. Any notice of Claim or reservation of Claim must clearly identify the alleged cause and the nature of the Claim and include data and information not available to the claimant that will facilitate prompt verification and evaluation of the Claim. Contractor’s timely written notice of Claim is a condition precedent to its entitlement to an adjustment of the Contract Sum, Contract Time or Contract Schedule.

§ 15.1.3 Continuing Contract Performance. Pending final resolution of a Claim, except as otherwise agreed in writing or as provided in Section 9.7 and Article 14, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments in accordance with the Contract Documents. The
Construction Manager will prepare Construction Change Directives and the Owner’s Representative will issue a Certificate for Payment in accordance with the decision reached.

§ 15.1.4 Claims for Additional Cost. If the Contractor wishes to make Claim for an increase in the Contract Sum based on extra work, written notice as provided herein shall be given before proceeding to execute such Work. Extra work performed by Contractor without prior written notice to, and authorization by, Owner shall be at Contractor’s sole risk and expense. Prior written notice is not required for Claims relating to an emergency endangering life or property.

§ 15.1.5 Claims for Additional Time
§ 15.1.5.1 If the Contractor wishes to make a Claim for an increase in the Contract Time, written notice as provided herein shall be given. The Contractor’s Claim shall include an estimate of cost and of probable effect of delay on progress of the Work. In the case of a continuing delay only one Claim is necessary.

§ 15.1.5.2 If adverse weather conditions are the basis for a Claim for additional time, such Claim shall be documented by data substantiating that weather conditions were abnormal for the period of time, could not have been reasonably anticipated and had an adverse effect on the scheduled construction.

§ 15.1.6 Claims for Consequential Damages. The Contractor and Owner waive Claims against each other for consequential damages arising out of or relating to this Contract. This mutual waiver includes

1. damages incurred by the Owner for rental expenses, for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons; and

2. damages incurred by the Contractor for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, and for loss of profit except anticipated profit arising directly from the Work.

This mutual waiver is applicable, without limitation, to all consequential damages due to either party’s termination in accordance with Article 14. Nothing contained in this Section 15.1.6 shall be deemed to preclude an award of liquidated damages, when applicable, in accordance with the requirements of the Contract Documents.

§ 15.2 RESOLUTION OF CLAIMS AND DISPUTES
§ 15.2.1 Decision of Owner’s Representative. Claims, including those alleging an error or omission by the Owner’s Representative but excluding those arising under Sections 10.3 through 10.5, shall be referred initially to the Owner’s Representative for decision. An initial decision by the Owner’s Representative shall be required as a condition precedent to litigation of all Claims between the Contractor and Owner arising prior to the date final payment is due, unless 30 days have passed after the Claim has been referred to the Owner’s Representative with no decision having been rendered by the Owner’s Representative. The Owner’s Representative will not decide disputes between the Contractor and persons or entities other than the Owner.

§ 15.2.2 The Owner’s Representative will review Claims and within ten days of the receipt of a Claim take one or more of the following actions: (1) request additional supporting data from the claimant or a response with supporting data from the other party, (2) reject the Claim in whole or in part, (3) approve the Claim, (4) suggest a compromise, or (5) advise the parties that the Owner’s Representative is unable to resolve the Claim if the Owner’s Representative lacks sufficient information to evaluate the merits of the Claim or if the Owner’s Representative concludes that, in the Owner’s Representative’s sole discretion, it would be inappropriate for the Owner’s Representative to resolve the Claim.

§ 15.2.3 In evaluating Claims, the Owner’s Representative may, but shall not be obligated to, consult with or seek information from either party or from persons with special knowledge or expertise who may assist the Owner’s Representative in rendering a decision. The Owner’s Representative may request the Owner to authorize retention of such persons at the Owner’s expense.

§ 15.2.4 If the Owner’s Representative requests a party to provide a response to a Claim or to furnish additional supporting data, such party shall respond, within ten days after receipt of such request, and shall either (1) provide a response on the requested supporting data, (2) advise the Owner’s Representative when the response or supporting data will be furnished or (3) advise the Owner’s Representative that no supporting data will be furnished. Upon
receipt of the response or supporting data, if any, the Owner’s Representative will either reject or approve the Claim in whole or in part.

§ 15.2.5 The Owner’s Representative will render an initial decision approving or rejecting the Claim, or indicating that the Owner’s Representative is unable to resolve the Claim. This initial decision shall (1) be in writing; (2) state the reasons therefore; and (3) notify the parties and the Owner’s Representative of any change in the Contract Sum or Contract Time or both.

§ 15.2.6 [intentionally omitted]

§ 15.2.7 In the event of a Claim against the Contractor, the Owner may, but is not obligated to, notify the surety, if any, of the nature and amount of the Claim. If the Claim relates to a possibility of a Contractor’s default, the Owner may, but is not obligated to, notify the surety and request the surety’s assistance in resolving the controversy.

§ 15.2.8 If a Claim relates to or is the subject of a mechanic’s lien, the party asserting such Claim may proceed in accordance with applicable law to comply with the lien notice or filing deadlines.

§ 15.3 [intentionally omitted]
SUPPLEMENTARY GENERAL CONDITIONS

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1. ESCROW AGREEMENT
Pursuant to IC 5-16-5.5, Contractor and Owner agree that Owner shall retain from progress payments and place in an escrow account under the control of a bank, savings and loan institution or the State of Indiana or an instrumentality thereof, selected by mutual agreement of the parties (“Escrow Agent”), for the purpose of accumulating and sharing the benefits which might accrue through normal interest payments. The parties shall execute a formal Escrow Agreement with the Escrow Agent, and the retainage shall be promptly invested with the Escrow Agent until such retainage is ordered released by the Owner or by other legal action, at which time the amount withheld plus accrued interest shall be paid to the Contractor, less service charges as specified in the Escrow Agreement. The Escrow Agreement shall be executed by the Contractor in accordance with Section 3.1.5 of the General Conditions and shall be one of the Contract Documents.

2. SUBSURFACE CONDITIONS
Cross-Reference to Instructions to Bidders, Article 5, and General Conditions, Section 3.2.1

A. Boring information, water levels, indications of surface and subsurface conditions and similar information given on the drawings or in the specifications are furnished only for the convenience of the Prime Contractors. Logs of available subsurface explorations, borings and drawings of existing site conditions may be examined by arrangement with the Owner. The Owner, Owner’s Representative and their Consultants make no representation regarding the character and extent of the soil data or other surface or subsurface data and conditions to be encountered during the work and assume no
responsibility and make no guarantee as to the accuracy or completeness of the information.

B. Each Contractor by careful examination, shall inform itself as to the nature and location of the work, the conformation of the ground, subsoil and ground water conditions, the character, quality and quantity of the materials to be encountered, the character of equipment and the facilities needed preliminary to and during the prosecution of the work, the general and local conditions and all other matters which can in any way affect the work under his Contract. Each Contractor shall make its own deductions of surface and subsurface conditions which may affect methods or cost of construction of the work of its Contract and Contractor agrees that it will make no claim for damages or other compensation, should it encounter conditions during the progress of the work different from those as calculated and/or anticipated by it.

3. COMPLIANCE WITH COMMON CONSTRUCTION WAGE REQUIREMENTS

Cross-Reference to Instructions to Bidders, Article 10, and General Conditions, Section 3.2.1

Contractor and subcontractors will notify employees of the common construction wage requirements for this Project, including contacts for filing an inquiry or complaint. The university's contact for inquiries is:

Capital Projects Business Office
1800 North Range Road
Bloomington, Indiana 47408
812 855 5294

For state labor issues such as compliance with the Indiana common construction wage statute, employees may contact:

Commissioner
Department of Labor
402 West Washington Street Room W195
Indianapolis, IN 46204-2739
Phone 317-232-2378
Fax 317-793-5257

A copy of Common Construction Wage Complaint Project Data Sheet is included in the specifications and will be made available by Contractor on the job site.

For federal labor law matters covered by the Fair Labor Standards Act, employees may contact:

U.S. Department of Labor
Wage & Hour Division

Indianapolis Office: phone 317-226-6801
South Bend Office: phone 574-236-8321

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4. **INDIANA UNIVERSITY DELIVERABLES REQUIREMENTS FOR CONSTRUCTION DOCUMENTS AND AS-BUILT & RECORD DOCUMENTS**

Cross-Reference to General Conditions, Section 3.11.4

**Overview of Project Document Deliverables**

**PROJECT SIZE CATEGORIES:** Deliverable requirements of construction projects for Indiana University are based on estimated projected costs associated within the scope of work. There are three categories:

1. Projects with an estimated cost at or over $5,000,000 and which would be publicly bid;
2. Projects with an estimated cost under $5,000,000 while also greater than $150,000 and which would be publicly bid;
3. Projects with an estimated cost at or under $150,000 for which invitational bidding would be solicited from pre-qualified contractors; and projects for which pricing was procured through Job Order Contracting (JOC) or other methods not qualifying for categories 1 or 2 above.

**STANDARD TIME POINTS:** While specific requirements for deliverables associated with each of the three above categories vary, the time points establishing the submission of contractual document deliverables for these categories do not. The following time points are based on long-standing practices followed by architects, engineers and contractors.

- **Contract Documents:** The process begins with review and acceptance of the construction design documents, known as “Contract Documents”, or commonly referred to as “CD’s”; these being either prepared by architectural and or engineering design consultants performing under contract to the University, or by IU’s in-house design professionals.

- **Bid Documents:** The CD documents (construction drawings, plans, specifications) along with bidding documents and any addendums, are presented as the project’s “bid documents” to construction contractors for competitive bidding. Then the selected contractor will use these documents to effect the project’s defined construction.

- **As-built and Record Documents:** During the construction phase, changes to the project that modify intent described in original Bid Documents (bid-upon set of plans and specifications) may arise.
  1. **As-built (or Field Data Set):** Changes are recorded by the contractor, resulting in an “as-built” set (paper or electronic) documents, which are maintained by the contractor through the project’s construction and then submitted by the contractor to the designer.
  2. **Record Drawings:** The designer compiles all As-builts submitted by contractor(s) into Record Drawings and/or Record BIM model(s), with the design consultant’s concurring review of what changes were denoted, why they were made (such as accepted alternate or a found condition, etc.), and where they occurred.

**Bid Document Deliverables** are prepared for the University by a design professional (either consultants performing under contract to the University, or by the University’s in-house design professionals when there is no consultant under contract for the project). Bid documents consist of construction drawings, plans, specifications, along with bidding directions and any addendums, in either or both of written and graphic formats. The design professional electronically transmits in .pdf format the full set of construction drawings, specification sections and the addenda to those documents. The University’s
printing contractor is responsible for paper reproduction and distribution to contractors who have registered to receive the bid documents in order to publically offer a bid proposal for construction of the project.

**Contract or Construction Documents Deliverables** are the same issue of documents cited in the paragraph above, however these deliverables are to be submitted to the University as they were natively created - in Revit .rvt and/or AutoCAD .dwg format and in Word .docx format. These file types are commonly required for public and invitational bid contracts. Within 10 days following award of bid for contract for construction, the design consultant must provide the UAO with one set of files in digital/electronic format as follows:

1. **CAD Files; one file each - representing *every sheet in the bid documents* and with *Addenda incorporated*:** Native CAD files shall be in .dwg format, one file for *each sheet* in the complete set *with all xrefs fully bound*. These documents must comply with University Architects’ Office CAD Standards. Use of AutoCAD e-transmit is recommended to bind each file.

2. **Word processing files:** all specifications shall be in native Word .docx format (other than those provided by IU Business Office for Divisions 0 & 1).

3. **Revit files:** a design model for each discipline. Refer to Indiana University BIM Guidelines and standards for Architects, Engineers and Contractors.

4. **COBie design submittal:** When the design of scope of work designates installation of “operating building equipment requiring on-going regular maintenance”, a COBIE Design submittal is also required to be submitted in standard COBie .xlsx workbook format with worksheet info completed for each of the following tabs at a minimum:
   - (Tab2) Facility-ies referenced in the design;
   - (Tab3) (Floor) description of vertical levels;
   - (Tab4) Spaces referenced in the project;
   - (Tab5) System- systems referenced in the project; referenced in the project;
   - (Tab6) Register-material or equipment types(submittal register);
   - (Tab7) Component – Individually named materials and equipment.

**As-Built Deliverables** are revisions to the construction documents based on changes that occur in the field. Contractor marks changes onto a field set of prints of the construction plans (required by their contract to be kept on site) as a log, denoting what and where the changes were made. The entire field set of plans denoting the changes are either scanned or created electronically by the contractor such that they clearly show and differentiate changed elements from originally intended. The resultant contractor’s field set drawing files (.pdf format file) must then be submitted to the design professional for review and to allow for producing necessary revisions to the native design program, whether created in a Revit Model or AutoCAD .dwg files. Changes may be indicated by either graphics or notations. The revised version recording all the changes in the field to the original construction documents is called a *Record Drawing*, created by the design professional. The submission of the contractor’s field set scans and the revised native design files must be in accord for acceptance by the University of these two “as-built documents.” The University requires electronic project deliverables be submitted via hard copy (CD or DVD). The deliverable should include: .dwg files for each document sheet, and all addenda & specification files. Use of “AutoCAD e-transmit” to bind all .dwg files is recommended to insure that no x-ref files, text files, or plot styles are lost in the submittal.
Refer to the Document Deliverables Matrix below for additional deliverables and their format(s).

**Specific requirements for Contractor’s field record of changes to contract drawings:**

The Contractor shall keep at the construction site a complete set of full size prints of the contract drawings, reproduced at Contractor expense. During construction, these prints shall be marked to show all deviations in actual construction from the contract drawings. The color red shall be used to indicate all additions and green to indicate all deletions. The drawings shall show the following information but not be limited thereto:

a. The locations and description of any utility lines and other installations of any kind or description known to exist within the construction area. The location includes dimensions and elevations of permanent features.

b. The locations and dimension of any changes within the building or structure, and the accurate location and dimension of all underground utilities and facilities.

c. Correct grade or alignment of roads, structures, and utilities if any changes were made from contract plans.

d. Correct elevations if changes were made in site grading from the contract plans.

e. Changes in details of design or additional information obtained from working drawings specified to be prepared and/or furnished by the Contractor including, but not limited to, fabrication erection, installation, and placing details, pipe sizes, insulation material, dimensions of equipment foundations, etc.

f. The topography and grades of all drainage installed or affected as part of the project construction.

g. All changes or modifications from the original design and from the final inspection.

h. Where contract drawings or specifications allow options, only the option actually used in the construction shall be shown on the as-built drawings. The option not used shall be indicated as deleted.

These deviations shall be shown in the same general detail utilized in the contract drawings. Markings of the prints shall be pursued continuously during construction to keep them up to date. This information shall be maintained in a current condition at all times until the completion of the work. The resulting field-marked data shall be referred to and marked as “As-Built Field Data” and shall be used for no other purpose. They shall be made available for inspection by IU’s representative whenever requested during construction and shall be jointly inspected for accuracy and completeness by IU’s representative and a responsible representative of the Contractor prior to submission of each monthly pay estimate. Failure to keep the As-Built Field Data (including Equipment-in-Place lists in
the COBIE spreadsheet) current shall be sufficient justification to withhold a retained percentage from the monthly pay estimate.

**Close-out / As-Built Documents Deliverable Requirements**

Indiana University requires that the As-Built Documents Deliverable be submitted via hard copy (CD or DVD and Paper). The electronic portion of this deliverable should include: .dwg files for each document sheet, .pdf files for each document sheet, As-built Field Data Set (a .pdf of each sheet), and O & M Manuals. When a sheet has no changes, it still must be included along with a notation of “no changes” on it. Use AutoCAD e-transmit to bind all .dwg files; this is the best way to insure that no x-ref files, text files, or plot styles are lost in the submittal. Follow the As-Built Document Matrix below to determine the responsible party for each deliverable, and in what format.

**O&M (Operations & Maintenance) Manuals**

The contractor shall submit to Indiana University – one pdf of the O&M manuals along with the Construction Operations Building Information Exchange (COBIE) file; which shall include: (1) the make, model and serial number of each piece of installed equipment, (2) the location of any equipment installed in the building.

**As-Built and Record Document Deliverable Matrix**

The following matrix outlines the various As-Built and Record Documents deliverables that are required on two different project categories with the associated responsible parties that will be in place for contracts entered into as of February 1, 2014. All deliverables identified in this article are to be provided as indicated.

**Document Deliverables Matrix**

The following matrix outlines the Document deliverables required on three different project categories; indicating the associated responsible parties. All deliverables identified in this article are to be provided as indicated.

**Responsible Parties**  A/E = Architect/Engineer  C = Contractor

<table>
<thead>
<tr>
<th>Construction Documents Deliverables</th>
<th>Resp. Party</th>
<th>Quantity</th>
<th>Format</th>
<th>Due Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>IU BIM Proficiency Matrix</td>
<td>A/E</td>
<td>1 set</td>
<td>.xlsx</td>
<td>Prior to selection as required</td>
</tr>
<tr>
<td>IU BIM Execution Plan</td>
<td>A/E, C</td>
<td>1 set</td>
<td>.docx</td>
<td>30 days after contract awarded</td>
</tr>
<tr>
<td>Design BIM Model(s)</td>
<td>A/E</td>
<td>1 set</td>
<td>.rvt</td>
<td>10 days after construction contract is awarded</td>
</tr>
<tr>
<td>Construction Document CAD Drawings</td>
<td>A/E</td>
<td>1 set</td>
<td>.dwg &amp; .pdf</td>
<td>10 days after construction contract is awarded</td>
</tr>
<tr>
<td>Addenda</td>
<td>A/E</td>
<td>1 set</td>
<td>.docx &amp; .pdf</td>
<td>10 days after construction contract is awarded</td>
</tr>
</tbody>
</table>
### Category 1 (continued):

<table>
<thead>
<tr>
<th>Specifications</th>
<th>Resp. Party</th>
<th>Quantity</th>
<th>Format</th>
<th>Due Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>A/E</td>
<td>1 set</td>
<td>.docx &amp;</td>
<td>10 days after</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>.pdf</td>
<td>construction</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>contract is</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>awarded</td>
<td></td>
</tr>
<tr>
<td>COBie Data (COBie setup)</td>
<td>A/E</td>
<td>1 set</td>
<td>.xlsx</td>
<td>10 days after construction contract is</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>awarded</td>
<td></td>
</tr>
</tbody>
</table>

### As-built and Record Documents Deliverables

<table>
<thead>
<tr>
<th>Record Document CAD Drawings and all project Affidavit(s)</th>
<th>Resp. Party</th>
<th>Quantity</th>
<th>Format</th>
<th>Due Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>A/E</td>
<td>(see note)</td>
<td>(see note)</td>
<td>* 1 set each .pdf &amp; .dwg on CD or DVD as well as 2 sets hard copy (paper). Prior to Final Payment</td>
<td></td>
</tr>
<tr>
<td>As-Built Field Mark-ups - Files and/or Scans</td>
<td>C</td>
<td>1 set</td>
<td>.pdf &amp; hard</td>
<td>At Substantial Completion &amp; Prior to Final Payment</td>
</tr>
<tr>
<td>Operations &amp; Maintenance Manuals (O&amp;M)</td>
<td>C</td>
<td>1 set</td>
<td>.pdf &amp; hard</td>
<td>At Substantial Completion &amp; Prior to Final Payment</td>
</tr>
<tr>
<td>COBie Construction Data</td>
<td>C</td>
<td>1 set</td>
<td>.xlsx</td>
<td>Prior to Final Payment</td>
</tr>
<tr>
<td>As-Built BIM Model(s)</td>
<td>A/E</td>
<td>1 set</td>
<td>.rvt</td>
<td>Prior to Final Payment</td>
</tr>
</tbody>
</table>

### Category 2: for Bid Projects with an estimated project cost under $5 million:

<table>
<thead>
<tr>
<th>Construction Documents Deliverables</th>
<th>Resp. Party</th>
<th>Quantity</th>
<th>Format</th>
<th>Due Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction Document CAD Drawings</td>
<td>A/E</td>
<td>1 set</td>
<td>.dwg &amp; .pdf</td>
<td>10 days after construction contract is awarded</td>
</tr>
<tr>
<td>Addenda</td>
<td>A/E</td>
<td>1 set</td>
<td>.docx &amp; .pdf</td>
<td>10 days after construction contract is awarded</td>
</tr>
<tr>
<td>Specifications</td>
<td>A/E</td>
<td>1 set</td>
<td>.docx &amp; .pdf</td>
<td>10 days after construction contract is awarded</td>
</tr>
<tr>
<td>COBie Data (COBie setup)</td>
<td>A/E</td>
<td>1 set</td>
<td>.xlsx</td>
<td>10 days after construction contract is awarded</td>
</tr>
</tbody>
</table>

### As-built and Record Documents Deliverables

<table>
<thead>
<tr>
<th>Record Document CAD Drawings and all project Affidavit(s)</th>
<th>Resp. Party</th>
<th>Quantity</th>
<th>Format</th>
<th>Due Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>A/E</td>
<td>(see note)</td>
<td>(see note)</td>
<td>* 1 set each .pdf &amp; .dwg on CD or DVD as well as 2 sets hard copy (paper). Prior to Final Payment</td>
<td></td>
</tr>
<tr>
<td>As-Built Field Mark-ups - Files and/or Scans</td>
<td>C</td>
<td>1 set</td>
<td>.pdf &amp; hard</td>
<td>At Substantial Completion &amp; Prior to Final Payment</td>
</tr>
</tbody>
</table>
**Category 2 (continued):**

<table>
<thead>
<tr>
<th>Deliverables</th>
<th>Resp. Party</th>
<th>Quantity</th>
<th>Format</th>
<th>Due Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operations &amp; Maintenance Manuals (O&amp;M)</td>
<td>C</td>
<td>1 set</td>
<td>.pdf &amp; hard</td>
<td>At Substantial Completion &amp; Prior to Final Payment</td>
</tr>
<tr>
<td>COBie Construction Data</td>
<td>C</td>
<td>1 set</td>
<td>.xlsx</td>
<td>Prior to Final Payment</td>
</tr>
</tbody>
</table>

**Category 3: non-public bid Projects at or under $150,000 of invitational bidding from contractors, or procured through job order contracting (JOC), or other methods not qualifying for categories 1 or 2:**

<table>
<thead>
<tr>
<th>Construction Documents Deliverables</th>
<th>Resp. Party</th>
<th>Quantity</th>
<th>Format</th>
<th>Due Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction Document CAD Drawings</td>
<td>A/E</td>
<td>1 set</td>
<td>.dwg &amp; .pdf</td>
<td>10 days after construction contract is awarded</td>
</tr>
<tr>
<td>Addenda</td>
<td>A/E</td>
<td>1 set</td>
<td>.docx &amp; .pdf</td>
<td>10 days after construction contract is awarded</td>
</tr>
<tr>
<td>Specifications</td>
<td>A/E</td>
<td>1 set</td>
<td>.docx &amp; .pdf</td>
<td>10 days after construction contract is awarded</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>As-built and Record Documents Deliverables</th>
<th>Resp. Party</th>
<th>Quantity</th>
<th>Format</th>
<th>Due Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Record Document CAD Drawings and all project Affidavit(s)</td>
<td>A/E</td>
<td>(see note)</td>
<td>(see note)</td>
<td>* 1 set each .pdf &amp; .dwg on CD or DVD as well as 2 sets hard copy (paper). Prior to Final Payment</td>
</tr>
<tr>
<td>As-Built Field Mark-ups - Files and/or Scans</td>
<td>C</td>
<td>1 set</td>
<td>.pdf &amp; hard</td>
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<tr>
<td>Operations &amp; Maintenance Manuals (O&amp;M)</td>
<td>C</td>
<td>1 set</td>
<td>.pdf</td>
<td>At Substantial Completion &amp; Prior to Final Payment</td>
</tr>
</tbody>
</table>

**Responsible Parties**  
A/E = Architect/Engineer  
C = Contractor

Responsible Party shall not be relieved of responsibility when files delivered do not meet established requirements or are defective. Indiana University shall verify all files and the Owner’s Representative shall be notified of acceptance.

**Submittal Standards**

**BIM (Building Information Modeling)** - refer to requirements in [The Indiana University Building Information Modeling (BIM) Guidelines For Architects, Engineers, and Contractors](http://www.iu.edu/~vpcpf/consultant-contractor/standards/bim-standards.shtml)

COBIE (Construction Operations Building Information Exchange) - for spreadsheets, instructions, and guidance go to:
http://www.wbdg.org/resources/cobie.php?r=om (COBie2.6 is the version to be used)

GIS/SITE – for Site, Civil, Landscape and Utilities guidance go to:
http://www.iu.edu/~vpcpf/consultant-contractor/standards/site-landscape.shtml

File Format Standards
BIM - Autodesk Revit .rvt - Revit version should closely be coordinated with entire team and Owner and indicated in IU BIM Execution Plan

CAD - Autodesk AutoCAD .dwg - format should be AutoCAD version 2014.dwg (AutoCAD release 2014) and each file named for each individual drawing sheet

PDF - Adobe pdf format should be configured to allow for text searches and printing. Pdfs should also be rotated to drawing/sheet orientation. Files should be named to match the individual sheet/drawing number.

RVT – (see BIM above).

Definitions
Affidavit – Signed letter affirmation to the University. A Code Affidavit would be the Architect/Engineer’s assurance of project’s design meeting current required restrictive codes and laws (such as ADA), and will also list any/all unique deviations allowed by the State to be taken, such as any variance(s). Environmental Affidavit would be the Architect/Engineer’s assurance of project’s design meeting current required environmental codes and laws, and will also list any and all unique deviations that may have been allowed by the legal jurisdiction. Check with Team Leader for required affidavits on project.

As-Built Documents - As-built documents are the collection of paper drawings or electronic drawings that typically reside in the contractor’s onsite trailer that contain mark-ups, annotations, and comments about changes that have been made to the contract documents during the construction phase.

As-Built Model - Design Intent Models that have been updated throughout the construction process. These changes and updates have been communicated from the Contractor to the Design Team through the comments, annotations, and mark-ups from the As-Built Documents. These typically, but not always, are discipline-specific models.

Building Information Model (BIM) - A digital representation of physical and functional characteristics of a facility; a shared knowledge resource for information about a facility forming a reliable basis of decisions during life-cycle, which is defined as existing conception to demolition.

BIM Execution Plan (BEP) - A plan that is created from Indiana Universities BIM Execution Plan Template that is to be submitted thirty (30) days after contract award. The BEP helps to define roles and responsibilities within a project team.
**BIM Proficiency Matrix (BPM)** - A matrix that was designed to measure the expertise of a firm as it relates to using a BIM process on projects. It will be used by Indiana University as one of the many selection criteria during the selection process.

**C.O.B.i.e. – Construction Operations Building Information Exchange** – COBIE spreadsheet replaces submission of multiple copies of paper documents delivered at the conclusion of construction. The data required by COBIE is the same information as is currently required by project handover/O&M data. The contractor is to insert installed equipment data in the spreadsheet that will link into designer provided space, and installation information.

**Operations and Maintenance Manuals (O&M’s)** – Includes all manufacturers’ warrantee information, product data and maintenance requirements and recommendations as would be required to properly and safely maintain installed building elements and equipment and maintain the warrantee status of same. Also shall include all temperature control drawings, fire protection system documents, security system documents, and Interior Finishes binders (in format as required by UAO Interiors Dept.)

**Record Drawing** - The production of Record Drawings is the capturing of the As-Built Documents’ annotations, comments, and mark-ups in a drawing format only. This requirement is separate of any updating of any models.

**Related Documents** (for others see VPCPF website: http://www.iu.edu/~vpcpf/consultant-contractor/index.shtml)

- **Interiors Standards** – (web page under construction as of date of this edition of this document)
- **Site and Landscape Standards** - http://www.indiana.edu/~uao/docs/standards/IU_Landscape.pdf

[End of Article 4]

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5. **LABOR CONDITIONS**

A. Each Contractor shall take all steps necessary to avoid any labor disputes or jurisdictional disputes, and strikes or delays resulting therefrom.

B. Each Contractor shall install in the work, and use in the prosecution of the work, only such materials, equipment and appliances as are produced and installed or applied without involvement in labor jurisdictional disputes, infractions or interferences, and strikes or delays resulting therefrom.

C. Each Contractor shall take all necessary steps to insure labor harmony on the Project and to perform work in accordance with federal, state and local labor regulations. No extra payment shall be due for doing work under this provision, or for delays or damages for failure to observe such requirements.

6. **OWNER- FURNISHED MATERIALS AND EQUIPMENT**

Cross-Reference General Conditions, Sections 3.2.1(6)(iii)(d) and Article 6

A. **Self-Performance by Owner** – Each Contractor shall permit the Owner to place and install equipment in accordance with a mutually-agreeable schedule before the completion of its work. The placing and installation of equipment shall not in any way be construed as evidence of the completion or acceptance of the work or any portion thereof.

B. **Contractor Installation of Owner-Furnished Materials and Equipment** – In the event that Owner elects to furnish materials or equipment to the Contractor for installation, such equipment or materials shall be noted, indicated or scheduled by the Owner and notice provided to the Contractor, and shall be carefully examined by the Contractor immediately after delivery to the site, and any and all conditions which would prohibit the proper installation or operation of this equipment shall be noted and the Owner informed thereof before acceptance of the materials or equipment for installation. The Contractor shall assume responsibility for such equipment and materials upon receipt thereof, and shall pay for any damage occurring after delivery.

7. **CONTRACTOR FURNISHED MATERIALS AND EQUIPMENT**

Cross-Reference General Conditions, Section 3.2.1(6)(iii)(d)

Contractor, subcontractors, manufacturers and suppliers furnishing materials and equipment under the various Prime Contracts shall identify, ship, address, consign, etc., all such materials and equipment to the appropriate Prime Contractor who may be charged therewith by giving the name of the Contractor, name of the Project, the street or post office address and the city and under no circumstances may shipments be directed to, or in care of Indiana University. It shall be the sole responsibility of all contractors, etc., to observe this
requirement, and failure to do so shall in no way be construed as a justifiable construction delay.

8. **EQUAL EMPLOYMENT OPPORTUNITY AND UNLAWFUL HARASSMENT**

Cross-Reference General Conditions, General Conditions, Section 3.3.2.1 and Article 10.5

A. **EQUAL EMPLOYMENT OPPORTUNITY**

1. During the performance of this Contract, each Contractor agrees as follows:

   a. The Contractor will not discriminate against any employee or applicant for employment because of race, religion, color, sex, national origin, marital status, age, sexual orientation, veteran status or disability. The Contractor will take affirmative action to ensure that applicants are employed and that employees are treated during employment without regard to their race, religion, color, sex, national origin, marital status, age, sexual orientation, veteran status or disability. Such action shall include, but not be limited to the following: employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by an appropriate agency of the Federal Government setting forth the requirements of these non-discrimination provisions.

   b. The Contractor will, in all solicitations or advertisements for employees placed by or on the behalf of the Contractor, state that all qualified applicants will receive consideration for employment without regard to race, religion, color, sex, national origin, marital status, age, sexual orientation, veteran status or disability.

   c. The Contractor will send to each labor union or representative of workers with which he has a collective bargaining agreement or other Contract or understanding a notice to be provided advising the labor union or worker's representative of the contractor's commitments under Section 202 of Executive Order #11246 of September 24, 1965, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

   d. The Contractor will comply with all provisions of Executive Order #11246 of September 24, 1965, and of the rules, regulations and relevant orders of the Secretary of Labor.

   e. The Contractor will furnish all information and reports required by Executive Order #11246 of September 24, 1965, and by the rules,
regulations and orders of the Secretary of Labor, or pursuant thereto, and will permit access to his books, records, and accounts by an appropriate agency of the Federal Government and by the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations and orders.

f. In the event of the Contractor's non-compliance with the Equal Opportunity conditions of this Contract or with any of such rules, regulations or orders, this Contract may be cancelled, terminated or suspended in whole or in part, and the Contractor may be declared ineligible for further Government Contracts, in accordance with procedures, authorized in Executive Order #11246 of September 24, 1965, and such other sanctions may be imposed and remedies invoked as provided in said Executive Order, or by rule, regulation or order of the Secretary of Labor, or as otherwise provided by law.

2. The Contractor will include all of Clauses (1 thru 4 inclusive, of this article) in every subcontract of purchase order unless exempted by rules, regulations or orders of the Secretary of Labor issued pursuant to Section 204 of Executive Order # 11246 of September 24, 1965, so that such provision will be binding upon each subcontractor or vendor. The Contractor will take such action with respect to any subcontractor or vendor as the appropriate agency of the Federal Government may direct as a means of enforcing such provisions, including sanctions for noncompliance; provided, however, in the event the contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction by the appropriate agency of the Federal Government, the contractor may request the United States to enter into such litigation to protect the interests of the United States.

3. Exempted from the above Equal Employment Opportunity conditions are construction contracts and subcontracts not exceeding $10,000, suppliers, contracts, and material and equipment contracts not exceeding $10,000 for standard commercial supplies or raw materials, and contracts and subcontracts under which work is performed outside of the United States where no recruitment of workers within the United States is involved.

4. In addition to the requirements set forth in Article 14 of the Instructions to Bidders regarding the participation of Minority and Women’s Business Enterprises ("MBE/WBE"), the Contractor is required to comply with the following Mandatory Tier II Reporting Requirement:

The Contractor shall take all necessary and reasonable steps to ensure that MBE/WBEs have the maximum opportunity to compete for and perform work on this Contract. MBE/WBE utilization in the performance of this Contract must be reported monthly using the IU Online Tier II reporting System. Compliance with Owner’s Mandatory Tier II Reporting Requirement is a pre-
condition for approval of pay applications. (For more information and training, see [http://www.Indiana.edu/~busdiv](http://www.Indiana.edu/~busdiv) and click on Tier II Reporting.)

The Contractor shall, upon Owner’s written request, provide documentation that contracts have been entered into and payments made to Tier II MBE/WBE firms as reported by Contractor.

B. **UNLAWFUL HARASSMENT**

1. The Contractor will not engage in, or tolerate by its employees, subcontractors or agents, any unlawful harassment, including sexual harassment as defined in this section. Harassment on the basis of race, color, religion, sex or national origin is a violation of Section 703 of Title VII of the Civil Rights Act of 1964.

2. Sexual harassment is defined as unwelcome sexual advances-requests for sexual favors and other verbal or physical conduct of a sexual nature when:

   a. Submission to such conduct is made either explicitly or implicitly a term or condition of an individual's employment, or
   
   b. Submission to or rejection of such conduct by an individual is used as the basis for employment decisions affecting such individual, or
   
   c. Such conduct has the effect of unreasonably interfering with an individual's work or academic performance or creating an intimidating, hostile or offensive working or learning environment.

3. The Contractor will ensure dissemination of this harassment policy to its employees and agents.
9. **INSURANCE REQUIREMENTS**

Cross-Reference General Conditions, Article 11

**INDIANA UNIVERSITY**
**MINIMUM INSURANCE REQUIREMENTS**
**FOR CONSTRUCTION, NON-CONSTRUCTION AND PROFESSIONAL DESIGN CONTRACTS**

**Obligations of Contractors and Consultants**

Contractors and Consultants (whether corporation, sole proprietorship or partnership) shall procure and maintain during the term of the contract and until final acceptance of the completed work under the contract, insurance of the types of coverages and minimum limits as identified here and shall provide the Owner with Certificate(s) of Insurance evidencing these coverages prior to beginning work. Contractors and Consultants shall be referred to herein as “Contractor,” irrespective of their area of expertise.

♦ It is the responsibility of the Contractor and Subcontractors to become familiar with Owner’s insurance requirements and to ensure that they can meet these requirements prior to submitting a bid to perform the work. **Please provide this exhibit to your insurance agent so the correct certificate can be issued without delay.**

♦ No Contractor or Subcontractor of any tier shall be on the jobsite or proceed with work, and shall not be paid for any work performed, until proper certificate(s) of insurance have been submitted to and approved by the Owner. All required insurance policies shall be written by a company(s) authorized to do business in Indiana. The Owner shall not be liable to any person for the failure of the Contractor or any Subcontractor to carry specified insurance.

♦ It is the responsibility of all Contractors to ensure that all of its Subcontractors also meet these insurance requirements.

♦ If any part of any coverage includes a deductible, self insurance, a captive insurance company or a fronting arrangement, the amount so covered must be disclosed on the certificate or in a separate letter from the Contractor. Owner reserves the right to approve of this coverage.

♦ **NOTE:** Contractor is required to meet the insurance specifications during the time of construction and during the warranty period, usually two years after the project is accepted by Owner.

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CERTIFICATE HOLDER:

The Trustees of Indiana University
1800 N. Range Road
Bloomington, In. 47405-2206

Insurance Requirements

1. General Liability
   • Construction Contracts
     o Each occurrence: $1 million
     o General aggregate: $2 million
     o Products and Completed Operations: $1 million
     o The "COMMERCIAL GENERAL LIABILITY" box must be checked
     o The "OCCUR" box must be checked
     o Per Project box must be checked
   • Design/Consultant Contracts
     o Each occurrence: $1 million
     o General aggregate: $2 million
     o The "COMMERCIAL GENERAL LIABILITY" box must be checked
     o The "OCCUR" box must be checked

2. Automobile Liability
   • The box(es) that is/are checked must include a check in the box for Any Auto or All Owned, Hired and Non-Owned Autos
   • Combined Single Limit coverage: $1 million.
   • If separate Bodily Injury and Property Damage limits are purchased, each must be $1 million.

3. Excess/Umbrella
   • Excess coverage per se is not required. However, any of the dollar amount requirements can be met by a combination of primary and excess coverage.
   • Excess/umbrella coverage must be per occurrence coverage.
4. Professional Liability

Any type of design or consulting contract requires Professional Liability coverage of at least $1 million.

Owner reserves the right to require increased limits of coverage if, in the opinion of the Owner, project is hazardous in nature or poses a higher than usual risk.

5. Worker’s Compensation

The Contractor shall procure and maintain a Workers’ Compensation policy to cover its obligation under the applicable laws of any state or federal government to its employees employed on the jobsite or elsewhere on this project, including its liability as an employer under common law (commonly known as Employer’s Liability Coverage “B”) with limits of not less than that listed below. Before commencing work, Contractor shall submit to the Owner a valid State Form 41321 (Certificate of Compliance – Worker’s Compensation and Occupational Diseases) or a facsimile thereof at Owner’s option. If the Contractor has no employees (i.e., a one-person shop) then a Certificate of Exception must be obtained from the State.

<table>
<thead>
<tr>
<th>Worker’s Compensation:</th>
<th>Statutory</th>
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<tbody>
<tr>
<td>Employer’s Liability: $500,000 each accident or disease</td>
<td></td>
</tr>
<tr>
<td>$500,000 policy limit</td>
<td></td>
</tr>
<tr>
<td>$500,000 each employee</td>
<td></td>
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</tbody>
</table>

6. Builder’s Risk Insurance

The Owner shall maintain during the course of construction Builder’s Risk Insurance in an amount of not less than one hundred percent (100%) of the insurable value of the completed work, including materials, equipment, and supplies on the site and to become a part of the completed work, subject to a $25,000 deductible. The Contractor shall bear responsibility for that deductible.

The insured shall be the Owner and the Contractor(s) as their respective interests may appear. The Contractor’s loss, if any, is to be adjusted with and payable to the Contractor upon written request to the Owner. The Contractor shall be responsible for and shall insure, if required by the Owner, all materials, equipment, supplies not on the site and to become a part of the completed work, Contractor’s equipment, tools, scaffolding, staging, towers, forms and temporary buildings, and other materials, equipment and supplies not intended to become a part of the completed work.
This provision shall not release the Contractor from its obligation to complete, according to plans and specifications, the work covered by the Contract and the Contractor and its Surety shall be obligated to the full performance of the Contractor’s undertaking.

**NOTE: Prompt notice of potential claims is required.** In the advent of an occurrence that might be covered by Builders Risk insurance, notice must be given to the University within one work day of the occurrence. Except for emergency repairs, no changes to damaged property will be made until an inspection is made.

**Insurance Policy Endorsements**

All insurance policies must provide the following endorsements to the policy and must be noted on the certificate(s): ¹

1. Additional Insured Endorsement (CG2010 10 01 and CG2037) or equivalent form required on General Liability, Automobile Liability and Excess/Umbrella Liability policies naming the Owner and/or Other Parties as defined in Owner’s Contract and including coverage for completed operations. Owner shall be identified as: “The Trustees of Indiana University, its officers, agents and employees.” **If additional insured status is automatically granted by the insurance form “where required by written contract” then it is sufficient to note that on the certificate with a reference to the form number. This must include information about the Excess/Umbrella coverage, e.g., “Excess coverage is following form.”**

2. Aggregate Per–Project Endorsement (CG2503) to the General Liability Policy indicating that the general aggregate applies separately to each project.

3. Waiver of Subrogation on General Liability, Automobile Liability, and Employer’s Liability/Workers’ Compensation Policies in favor of the Owner.

4. All insurance policies shall be primary and non-contributing with respect to any insurance carried by the Owner, and shall contain a severability of interests clause in respect to liability, protecting each insured as though a separate policy had been issued to each.

5. All policies shall contain a covenant requiring (30) days written notice by the insurer to the Indiana University Office of Risk Management before cancellation, reduction or other modifications of coverage for any reason, **whenever possible.**

**Certificate Details**

**Description of Operations**

The DOO must include the Indiana University project name and project number to which this coverage applies.

¹ An addendum to the COI can be used if additional space is needed.
Insurance Companies

All insurance carriers selected by contractor must be rated “A-” or above in the most recent edition of the “A.M. Best’s Key Rating Guide.”

Hold Harmless Agreement

Contractor shall indemnify and save harmless the Owner from any and all losses, costs, damages, liability and expenses, including reasonable attorney fees, arising out of or in conjunction with claims or suits for damage to any property not included in the scope of work and/or injury to persons, including Contractor’s employees and all Subcontractor’s employees of any tier, including death, alleged or claimed to have been caused by or through the performance of the work or operations incidental to the work by the Contractor, its agents or employees, or by its Subcontractors of any tier, their agents or employees, whether through negligence or willful act; and Contractor shall, at the request of Owner, undertake to investigate and defend any and all such claims or suits against Owner.

Hold Harmless Agreement—Consultants

With regard to losses, costs, damages, liability and expenses, including reasonable attorney fees (“Losses”) that may be covered by Consultant’s professional liability insurance, Consultant shall indemnify and save harmless the Owner from any and all Losses arising out of or in conjunction with claims or suits for damage to any property not included in the scope of work and/or injury to persons, including Consultant’s employees and all employees of a Sub-Consultant, if any, of any tier, including death, caused by or through the performance of the work or operations incidental to the work by the Consultant, its agents or employees, or by its Sub-Consultants, if any, of any tier, their agents or employees, whether through negligence or willful act and Consultant.

With regard to losses, costs, damages, liability and expenses, including reasonable attorney fees (“Losses”) that may be covered by Consultant’s other liability insurance programs, Consultant shall indemnify and save harmless the Owner from any and all losses, costs, damages, liability and expenses, including reasonable attorney fees (“Losses”), arising out of or in conjunction with claims or suits for damage to any property not included in the scope of work and/or injury to persons, including Consultant’s employees and all employees of a Sub-Consultant, if any, of any tier, including death, alleged or claimed to have been caused by or through the performance of the work or operations incidental to the work by the Consultant, its agents or employees, or by its Sub-Consultants, if any, of any tier, their agents or employees, whether through negligence or willful act and Consultant shall, at the request of Owner, undertake to investigate and defend any and all such claims or suits against Owner.
10. **CLOSE-OUT PROCEDURES**

Cross-Reference General Conditions, Section 9.8 and, 9.9

These Close-out Procedures are governed by Project Drawings, General Conditions, these Supplementary Conditions and provide the administrative and procedural requirements for contract closeout.

**At Substantial Completion**

A. Before requesting inspection for determining date of Substantial Completion, Contractor shall complete the following:

1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
2. Advise Owner of pending insurance changeover requirements.
3. Furnish to the Owner a pdf version, searchable and printable, of the Maintenance and Operating Instructions and parts lists for all operating, general, mechanical, electrical, and control equipment and all other manufactured items installed by the Contractor. The operating instructions shall integrate each piece of equipment in any one system in to a numbered step by step sequence of operation. The parts listed shall consist of exploded views or parts listing, with all component parts numbered, for each piece of operating or expandable equipment. These operating instructions and parts lists must be furnished to the Owner prior to the time when the equipment is checked out and turned over to the Owner for operation or before the final payment on the Contract will be processed.
4. Submit As-Built Field Data Set Scans.
5. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
6. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
7. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner.
8. Label with manufacturer's name and model number where applicable.
9. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
10. Complete startup testing of systems.
11. Submit testing, adjusting and balancing records.
12. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
14. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
15. Complete final cleaning requirements.
16. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects, including touchup painting.

B. Submit a written request for inspection for Substantial Completion. On receipt of request, Owner’s Representative will either proceed with inspection or notify Contractor of unfulfilled requirements. Owner may assign its own staff to accompany Owner’s Representative on the inspection and may require Owner’s Representative and Consultants to provide additional inspections. Owner’s Representative 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 Owner’s Representative that must be completed or corrected before certificate will be issued.

C. Reinspection: Contractor shall request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

D. Results of completed inspection will form the basis of requirements for Final Completion.

**List of Incomplete Items (Punch List)**

A. Preparation: Submit one (1) copy of list in PDF format. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
2. Organize items applying to each space by major element, including categories for sitework, building exterior, roof, ceiling, individual walls, floors, equipment, and building systems.
3. Include date for completion of each incomplete item.
4. Include the following information at the top of each page:
   a. Project name.
   b. Date.
   c. Indiana University Project Number:
   d. Name of Owner’s Representative.
   e. Name of Contractor.
   f. Page number.

B. All Punch List items shall be complete within sixty (60) days from original date of punch list inspection.

C. Do not use extra materials required by Contract Documents to be delivered to Owner to repair or correct Punch List items.

**Prior to Final Completion and Final Payment**
Before requesting final inspection for determining date of Final Completion, Contractor shall complete the following:

A. Submit a final Application for Payment.

B. Prepare and submit Project Record Documents, Record Drawings, Record Specifications, Final Completion construction photographs, damage or settlement surveys, and similar final record information.

C. Orient and instruct the maintenance personnel designated by the Owner in the operation and maintenance of all equipment installed by the Contractor.

D. Submit the following:
   2. Final approved Lock-Out/Tag-Out manuals as identified in the Project Specifications.
   3. Certified copy of Owner’s Representative's Substantial Completion inspection list Punch List items, endorsed and dated by Owner’s Representative. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
   4. Evidence of final, continuing insurance coverage complying with insurance requirements.
   5. Pest-control final inspection report and warranty.
   6. Demonstration and training DVDs.
   7. Evidence of completion of Contractor documentation submittals for LEED credits that involve Contractor input.

E. Submit a written request for final inspection for acceptance. On receipt of request, Owner’s Representative will either proceed with inspection or notify Contractor of unfulfilled requirements. Owner’s Representative will conduct the inspection to verify that construction is in compliance with Contract Documents and authorities having jurisdiction. Owner may assign its own staff to accompany Owner’s Representative on the inspection and may require Owner’s Representative and Consultants to provide additional inspections. Owner’s Representative 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.

F. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
Indiana University Project Site Requirements

Index to Sections

1. Temporary Structures, Signs, Fences, Field Offices and Phones.
2. Temporary Hoists, Chutes, Derricks, Scaffold, Stairs, Etc.
3. Temporary Services (General)
4. Temporary Toilets
5. Temporary Water and Fire Protection
6. Temporary Light and Power
7. Temporary Heating/Cooling
8. Temporary Use of Elevators
9. Temporary Enclosures and Ventilation
10. Protective Coverings and Measures
11. Temporary Material Storage
12. Existing Utilities
13. Construction Loads on Building Structures
14. Site Drainage, Pumping and Storm Water Management
15. Waste Disposal and Asbestos Handling
16. Mandatory Environmental Health and Safety Training
17. Temporary Access to Site and Parking

The following Site Requirements shall be observed on all Indiana University Projects. These requirements are articulated as if the project is a multi-prime project. In the event that this is a single Prime project, all references to “Each Contractor” shall be construed to mean the “General Contractor.”

TEMPORARY STRUCTURES, SIGNS, FENCES, FIELD OFFICES AND PHONES

A. Structures – Each Contractor shall construct and maintain, in locations approved by the Owner’s Representative, all temporary structures, material sheds, storage sheds, or other similar enclosed structures required for the performance of this Contract. All temporary structures are to be removed from the site by the Contractor upon completion of the Project, or sooner, if so requested by Owner’s Representative.

B. Construction Sign – The General Contractor shall construct and maintain one construction sign 4’ high by 8’ long, or 32 square feet, constructed of plywood properly mounted and framed. The information appearing on this sign shall be as directed by the Owner’s Representative and will, in general, include the following:

<table>
<thead>
<tr>
<th>Owner’s Name</th>
<th>Consultant's Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name of Project</td>
<td>General Contractor's Name</td>
</tr>
<tr>
<td>Owner’s Representative’s Name</td>
<td>Mechanical Contractor's Name</td>
</tr>
<tr>
<td>Engineer's Name</td>
<td>Electrical Contractor's Name</td>
</tr>
</tbody>
</table>

1. No additional signs will be permitted without the written consent and approval of the Owner and Owner’s Representative.
2. Signs shall be provided with treated wood posts and 3/4” thick exterior grade (A-C faces) plywood panels, all substantially constructed and adequately braced.

3. All lumber, plywood and bracing shall be painted two coats of exterior paint on all exposed surfaces, in colors designated by the Owner’s Representative.

4. All lettering, graphics and colors shall be in accordance with the designs furnished by the Owner’s Representative.

5. General Contractor shall remove construction sign from site when directed by Owner’s Representative.

C. Construction Fence – The General Contractor shall furnish, erect and properly maintain a temporary “chain link fence”, 6’ 0” high, complete with privacy fabric, top and bottom horizontal support, man and vehicle gates as appropriate for the project conditions, which shall remain in place until such time as directed by the Owner to be removed. The fence shall be located on the Contract Limit Line or where the progress of work dictates.

D. Contractors’ Field Offices – Each Contractor shall provide at all times, for his own use, an adequate, weather tight temporary field office, located on the site in a location approved by the Owner’s Representative.

E. Owner’s Representative's and Owner's Field Offices – The General Contractor shall provide late model field office trailers of not less than 600 total square feet, for the use of the Owner’s Representative, Owner, and their representatives. These spaces shall be heated (thermostatically controlled), air conditioned, and lighted. Each shall be provided with clean and adequate toilet facilities, including water and sanitary services. When directed, the Contractor shall move the Owner’s Representative's and Owner's Field Offices into suitable space in the building.

1. The General Contractor shall provide a desk with chair and 8-foot long plan table, two plan racks, one 4-drawer legal size file with locks, one table adequate for seating 12 persons and 12 folding chairs, a telephone, and fire extinguishers.

2. The General Contractor shall supply and pay for all maintenance, janitorial services in connection with the Owner’s Representative's & Owner's Field Offices. The General Contractor shall provide and pay for the installation of telephones, using the Owner's telephone system, where possible, for use by the representatives of the Owner and the Owner’s Representative. The Owner will pay for the use of the telephones to be used by the Owner and the Owner’s Representative.
F. **Temporary Phones** – Telephone services are available in the vicinity of the construction site, and each Contractor shall deal directly with the local telephone company for its individual needs. The General Contractor shall have installed and maintained one or more field telephones for the use of its personnel during the entire construction period.

G. **Internet Access** – The Contractor is required to have internet access, as well as printing capabilities, on site at all times during construction operations.

2. **TEMPORARY HOISTS, CHUTES, DERRICKS, SCAFFOLD, STAIRS, ETC.**

A. **Contractor to Provide** – Each Contractor shall furnish and maintain all equipment such as temporary hoists, chutes, derricks, scaffolds, staging, stairs, ramps, runways, ladders, and similar items required for the proper execution of its work, and shall provide or arrange for the use of such facilities by all its subcontractors or trades as required to carry out its work, and shall remove or arrange for the removal of all such items when no longer required.

B. **Legal Requirements** – All such apparatus, equipment and construction shall meet the requirements of the labor laws and regulations applicable thereto and of the authorities having jurisdiction over same.

C. **Removal of Rubbish--General** – No materials, rubbish or debris will be permitted to drop free, but shall be removed by use of the material hoist, rubbish chute (closed, dust-tight type) or other method approved by the Owner’s Representative. Rubbish shall be removed frequently; daily from the building, weekly from the site. Specific requirements related to waste disposal and stormwater management are set forth in Section 17.

D. **Protection of the Work** – No materials will be permitted to be passed through the finished openings of the exterior walls without proper protection of the openings in a manner approved by the Owner’s Representative. Hoists and chutes shall be so protected as to prevent damage, staining or marring of any permanent work.

E. **Temporary Stairs** – Permanent stairs shall be erected as soon as possible and the General Contractor shall provide same with temporary protective treads, risers, handrails and shaft protection. The General Contractor shall provide safe, convenient access from floor to floor as the construction progresses. Permanent ladders and stairs may be used when available, providing same shall be safely prepared for such use. All devices so used shall conform to the Standards prescribed in the Safety Code for the Construction Industry, State of Indiana, to OSHA, and such other codes as are applicable.

F. **Temporary Sidewalks** – The General Contractor shall erect temporary sidewalks as required where existing sidewalks are rendered inadequate by work on the Project site. Temporary sidewalks shall be complete with all necessary timber uprights, braces, crossbeams, plank walk, railings and the like, all installed in such manner so
as not to interfere with the execution of the work, or safety and convenience of all persons using walks.

G. Temporary Sidewalk and Materials Bridges – The General Contractor shall erect temporary sidewalks and materials bridges, if required, where building operations are conducted within 30 feet of public sidewalks in order to provide adequate protection to the public and the Owner during the execution of the work of all Prime Contracts. The General Contractor shall construct bridges complete with necessary up-rights, braces, cross beams, plank top and screened guard rails on all sides and ends, and with watertight ceiling, lighting, signs and safety barricades, all in strict accordance with the requirements of local ordinances and regulations.

3. TEMPORARY SERVICES (GENERAL)

On projects for new construction, the General Contractor shall arrange for and pay all costs in connection with the furnishing and maintaining of all temporary toilets, water supply, light and power, heating, cooling, natural gas, chilled water, steam and local telephone service as required for the proper and expeditious prosecution of the work of all Prime Contracts. The General Contractor shall provide metering for temporary water and electrical utilities. The General Contractor shall make all connections to existing services and sources of supply, shall provide all necessary installations, labor, materials, and the like, in a manner subject to the approval of the Owner’s Representative and shall remove the temporary installations and connections when no longer required, or when so directed by the Owner’s Representative.

4. TEMPORARY TOILETS

A. The General Contractor shall provide, erect, service and maintain temporary toilets of an approved type at convenient locations on the premises, and through the building as construction progresses, for use by all Contractors and their workers on the Project. The General Contractor shall connect same to existing sanitary sewer lines or to the building sanitary sewers as completed. Toilets shall be maintained in a sanitary condition and equipped for the use of all workers.

B. When permanent toilet facilities can be provided within the building, the temporary structures and facilities shall be removed and disposed of by the General Contractor, closing all temporary openings in an acceptable permanent manner. Workers on-site after the temporary toilet facilities are removed may use those permanent toilet facilities identified by the Owner. These permanent toilet facilities shall be serviced regularly and returned to the Owner in first class condition when the Project is completed.

5. TEMPORARY WATER AND FIRE PROTECTION

A. The General Contractor shall provide and pay for the installation, maintenance and removal of a 2-1/2” combination temporary fire protection and service water stand pipe at 1/4 points of the building - total of four stand pipes, for use by all
Contractors on the Project. Each stand pipe, at each floor, shall be equipped with 1 1-1/2” valve, 100 ft. of fire hose in an enclosure painted red, plainly marked for fire only, plus two 3/4” hose bibs not enclosed. The fire hose shall be maintained in operable condition at all times and shall be used only for fire protection. Any Contractor requiring water at points other than those identified in this Paragraph shall be responsible for, and pay for any extension necessary.

B. The stand pipes shall be installed as quickly as construction permits and shall be extended floor by floor as the building construction progresses.

C. In addition to the fire hose, the General Contractor shall provide, install and pay for one ABC type fire extinguisher and one CO2 type fire extinguisher at each fire hose location. The extinguishers shall be in an enclosure, painted red, and plainly marked for fire only.

D. In addition to the fire protection described above, wherever and whenever any soldering, cutting, burning or welding operations are in progress or any equipment is in use, or any work is being performed that involves a fire hazard, the Prime Contractor that is responsible for such operation shall be responsible for maintaining an acceptable fire extinguisher within five feet of such an operation. At all times when any of the previously described operations are being performed that might result in flying sparks, hot slag, etc., the Contractor responsible for the operator's performance shall furnish a fire blanket of sufficient size to prevent the sparks, hot slag, etc., from coming in contact with combustible material. In particular, guard against passing of sparks, heated slag, etc., through pipe sleeves, duct openings, conduit openings or similar apertures by the use of an asbestos blanket.

E. The General Contractor shall pay for all service deposits and water used for construction, and shall furnish and install all materials and equipment necessary for a metered water service, for use by all Contractors on the Project. Further, the General Contractor shall fully inform itself as to connection point or points and water pressure available.

F. Contractor shall comply with owner’s hot work permitting requirements, which will be addressed in the mandatory Environmental Health and Safety training required by Section 16 of these Project Site Requirements.

G. Temporary Fire Alarm. The General Contractors shall install, maintain and remove a temporary wireless fire detection system to be provided by the Owner as quickly as construction permits and in accordance with guidance from the local Authority Having Jurisdiction. Temporary devices shall be located in the same general locations as indicated for permanent devices. The system shall be returned to the Owner after removal. The fire detection system must be connected through the MDF Room and report to the local Indiana University Police Department.

H. The permanent fire detection and controls equipment associated with the HVAC systems must be completely installed and programmed 120 days before substantial
completion. The permanent fire detection system throughout the building must be operating 90 days prior to substantial completion.

I. Temporary Building Data Network  The General Contractor shall be responsible for furnishing and installing sufficient facilities to provide access to the IU data network. This network access is required to serve alarm systems such as fire and security during construction. IU will provide a network switch in the MDF of buildings under construction. The room housing the temporary service (this can be the MDF) must be secured with the key lock, it must contain a UPS with 4-hour run time, line power must be available, and the space must be conditioned with AC and filtered air to prevent dust entrainment. Permanent pathways from the source of the IU network to the MDF is preferred, and may be used for temporary network access. Temporary pathways from the source of the IU network to the temporary room is allowed, and must be removed and replaced with permanent pathways as part of the project.

6.临时照明和电力

A. The General Contractor shall arrange for and pay for all metered temporary electric light and power for the work of all Prime Contractors and their trades and subcontractors as required throughout the work by the Prime Contractors. The General Contractor shall pay all costs for the installation, maintenance and use of equipment for such temporary light and power, including metering of temporary electrical power.

1. The General Contractor shall make all necessary arrangements to provide temporary electrical power, to arrange for its distribution, to continue its service throughout construction, to remove same, and to pay for all costs incidental thereto, all as identified herein.

2. Electrical power at 120/208/480 volts - 3 phase, 4 wire capability is available within convenient reach of the project.

3. Temporary lighting that complies with applicable federal and state codes shall be continuously provided in all stairways, corridors, and in all other work areas for all Contractors on the project. The General Contractor shall also provide as needed; area flood lights, guard lights at barricades, obstructions in streets, drives, walks and at all trenches or pits adjacent to public areas within the area of construction by any Contractor on this project.

4. The service entrance shall terminate in a minimum of two 400 ampere fused NEMA 3R rain tight main switches. From the service entrance location there shall be a minimum of two 400 ampere feeders to a minimum of two fused distribution panel boards on each floor. Such distribution panel boards shall be located at third points of the building and shall contain proper fusing for all temporary wiring extensions. Transformers required for the service outlined shall be provided as a part of the service entrance.
5. Temporary distribution from these panels shall provide single phase, 120 volt, 20 ampere service to outlets within 50 feet of any portion of the building, and a single phase, 208 volts, for a 10 horsepower maximum capacity within 200 feet of any portion of the building. Outlets and bulbs shall be provided by the General Contractor to produce not less than 1/5 watt per square foot of floor area throughout the building.

6. All temporary wiring shall include a green equipment grounding conductor and the entire temporary system shall have equipment grounding continuity. All outlets for the connection of portable electrical equipment shall be of the grounding type. All elements of the temporary electric service shall conform to the regulations of the National Electric Code, the National Electric Safety Code, the Safety Code for the Construction Industry, and O.S.H.A., which shall include such ground fault service as required to protect operating personnel.

7. Each Contractor and/or subcontractor shall furnish any necessary wiring and extension cords to reach from the nearest outlet to its point of operation. All such devices shall conform to the above provisions or be rejected for use by the Owner’s Representative or Owner.

8. No permanent power from permanent sources shall be used without the Owner's written permission indicating the conditions whereby it may be used. Consideration will not be given for the use of lights, wiring devices or other electric equipment until the building is in the finishing stages or unless it is in the Owner's interests.

9. The General Contractor shall maintain strict supervision over the use of the temporary electric service and shall be responsible for damages caused by misuse of same. Violation of safe practices, abuse of the service, or failure to conform to the above standards shall be sufficient cause for the Owner’s Representative or Owner to take such action as will correct the condition.

10. Upon completion of the Project or when directed by the Owner’s Representative, all temporary light and power equipment shall be removed by the General Contractor.

7. TEMPORARY HEATING/COOLING

A. The General Contractor shall be responsible for furnishing and installing and subsequent removal of a temporary metered heating/cooling system for use by all Contractors on the Project, within the new building as weather and construction conditions demand, and as required for the installation of any material or for working conditions required by any trade or trades within the building. Temporary heat shall
be provided to prevent freezing within the building, to provide suitable working conditions, to assure progress of the operation within the established schedule time, and to conform to specific requirements of the Contract Documents. In areas where finishing trades are working or have completed their work, temporary heat shall be maintained at a uniform temperature of 70° F until the completion of the Project.

B. The General Contractor shall provide and pay for all materials, labor, water, tools, electric wiring, fuel, and electric power, operating services and any items incidental and required for a complete and operable system of temporary heat, so long as any system of temporary heating/cooling is in operation and required by any trade or crafts within the building.

C. The General Contractor shall maintain a system of temporary heating/cooling until total completion and final acceptance by the Owner, even if the Owner exercises its right, pursuant to Section 4.5.2 of the General Conditions to take Beneficial Occupancy of some or all of the building. The entire cost of providing temporary heating/cooling shall be the responsibility of the General Contractor until substantial completion.

D. Equipment shall be oil or gas fired, electric blower operated, and shall not require a vent from the heated/cooled space. Open flame type units similar to Salamanders shall not be used.

E. All spaces where temporary heating/cooling is required shall be maintained at a minimum of 50° F. during working hours and at a minimum of 40° F. during non-working hours, or as required for building construction or any trade requirements. Also, for a minimum of seven days prior to any interior finishing, (wood, painting, varnishing, resilient tile, acoustical ceilings, etc.) and until final acceptance by Owner or during partial occupancy by Owner, spaces shall be maintained according to design conditions on a 24 hour, 7 days basis.

F. None of the permanent heating/cooling systems nor any of their component parts shall be available for temporary heating/cooling until the building is in the finishing stages, (finish painting, varnishing, paneling, wood, resilient tile, acoustical ceiling, etc.). At the point at which the permanent heating/cooling system is completely installed as designed, including permanent wiring connections to a permanent power source, the Contractor may make a request, in writing, to the Owner to use the permanent heating/cooling systems to supply temporary heating/cooling for the remainder of the Project. The Owner shall be sole judge of building conditions and heating/cooling system conditions concerning the permission to use the permanent heating/cooling systems for supplying temporary heating/cooling. Furthermore, if Owner grants permission for Contractor to use the permanent heating/cooling systems for temporary heating/cooling, the warranty on such permanent heating/cooling systems, including their component parts, shall not start to run until Contractor ceases its use of the permanent heating/cooling systems.
G. The General Contractor shall be responsible for all phases of operation, maintenance, and items of like nature during the time the permanent heating/cooling system is used to furnish temporary heating/cooling. The General Contractor shall assume all responsibility of coordination among other Contractors and/or trades concerning the installation of their permanent systems for use for temporary heating/cooling and extension of the warmth/cooling.

H. At the termination of the use of the permanent systems as a temporary heating system, the systems shall be cleaned, equipped with new filters, equipped with new belts if required, etc., and any damage repaired or replaced at the expense of the General Contractor.

8. **TEMPORARY USE OF ELEVATORS**

   A. *Temporary Use* – The General Contractor may arrange for the temporary use of elevators by all Prime Contractors, if required, during the construction period, to transport equipment and materials only during the finishing stages of the Project.

   B. *Temporary Cars* – The General Contractor shall furnish the required cars with car switch, gate contact, and all necessary operating and safety devices, city and state tests and certificates.

   C. *Temporary Cab Enclosures, Etc.* – The General Contractor shall provide the required cab enclosures, temporary hoistway entrances and hoistway doors, temporary protection of hoistway openings, protection of permanent hoistway entrances or other installed finished work, and such other items as are necessary to permit temporary operation in accordance with local, state and national codes. The General Contractor shall provide all necessary maintenance of the elevators during the period of temporary operation. The General Contractor shall restore elevators to their original perfect condition and furnish guarantee as specified. All costs in connection with operation of the temporary elevators shall be paid by the General Contractor. The General Contractor shall extend all guarantees and warranties for two (2) years from date of acceptance of the Project by the Owner.

9. **TEMPORARY ENClosures AND VENTILATION**

   A. The General Contractor shall provide temporary enclosures for all exterior openings, as soon as the building structure is erected and otherwise made weather-tight, or whenever necessary in order to provide suitable working conditions within the building. The General Contractor shall provide suitable means for ventilation of the building and to permit the exit of water vapor from the building at all times. The permanent door enclosures shall not be used as temporary enclosures, but temporary doors with proper hardware to make them self-closing shall be provided.

10. **PROTECTIVE COVERINGS AND MEASURES**
A. **Finished Surfaces** – The General Contractor shall protect all finished surfaces, including the jambs and soffits of all openings used as passageways or through which materials are handled, against any possible damage resulting from the conduct of work by all Prime Contractors and their trades and subcontractors.

   1. The finished surfaces shall be clean and not marred upon delivery of the Project to the Owner. The General Contractor shall, without extra compensation, replace, repair or refinish (as determined by the Owner’s Representative) all such spaces where painted or finished surfaces prove to have been inadequately protected and are damaged.

B. **Materials Stored on Finished Surfaces** – The General Contractor shall provide tight, non-staining wood sheathing under any materials that are stored on finished surfaces and shall provide planking on finished surfaces before moving any materials over those finished areas.

C. **Roof and Waterproof Surfaces** – Roof and waterproof surfaces shall not be subjected to traffic, nor shall they be used for storage of material. Where some activity must take place in order to carry out the work of the Prime Contracts, adequate protection, subject to approval by the Owner’s Representative, shall be provided by the General Contractor.

D. **Glass** – All glass shall be protected and kept clean during the entire construction period by the General Contractor. All damaged, etched, defaced or broken glass shall be replaced at the General Contractor's expense.

11. **TEMPORARY MATERIAL STORAGE**

   A. The General Contractor shall be responsible for and shall cooperate and coordinate with other Contractors requiring storage at the site.

   B. All Contractors on this Project shall be restricted to the “Contract Limit Lines” of the construction site and/or to any additional area as shown on the Site Plan and shall verify locations with the Owner’s Representative prior to storing any materials.

   C. All Contractors on this Project shall confine equipment, storage of materials, and the operations of workers to limits indicated on the drawings. Any area indicated on drawings or designated elsewhere by the Owner for storage of materials shall be returned to its original condition upon completion of the Project at no cost to the Owner.

   D. Should any Contractor require additional storage area, acquisition of such additional storage shall be at that Contractor's expense, shall not be on Owner’s property and shall not be invoiced or otherwise charged to Owner on monthly pay applications.
12. EXISTING UTILITIES

A. Notification of Utility Companies – The General Contractor, in accordance with local laws and ordinances, shall notify appropriate utilities, with copy to the Owner’s Representative and Owner, not less than 48 hours in advance of any excavation or work in, around or on utility lines.

B. Protection and Maintenance of Existing Utilities – Existing utilities are shown in the Contract Documents in their approximate locations from available information. The General Contractor shall ascertain exact locations of utilities that may be affected by the work of all Prime Contractors on this Project, and shall be responsible for the protection and maintenance of such utilities, and shall be responsible for any damage or injury that may result from working on or near these utilities.

C. Utilities Not Indicated – If existing utilities are encountered which are not indicated on the drawings, the General Contractor shall protect such utilities and notify the Owner’s Representative and the Owner of their presence. If any such utilities not indicated on the drawings which are to remain in service are damaged by any of the Prime Contractors, the General Contractor shall take such action as reasonably required to minimize the damage and shall promptly restore the system to operating condition as directed by the Project Engineer and the Owner’s Representative.

D. Owner-Provided Systems - The Contractor shall in no circumstances tap into Owner-provided systems, including but not limited to steam, without prior notice to the Owner. Upon obtaining the Owner’s consent, the Contractor shall schedule the tap-in at a time when Owner’s personnel can be present. If Contractor fails to comply with this provision, Contractor shall be reimburse the Owner for all costs incurred, including but not limited to all damages incurred and not covered by Builders Risk insurance for any reason, whether to property included or not included within the original scope of work.

13. CONSTRUCTION LOADS ON BUILDING STRUCTURES

The structure is designed to support the loads of the finished building. No provision is included for stresses or loads imposed by construction operations. If the Contractor desires to place such loads in excess of the design load (shown on drawings), it shall submit drawings and calculations prepared by, and bearing the seal of a Professional Engineer of the proposed method for supporting such loads for the Owner’s Representative's review and approval. No loading of any kind in excess of design loads shall be placed on any part of the building structure prior to Owner’s Representative's approval of submitted drawings and calculations. The costs of the Owner’s Representative's review shall be borne by the Contractor.

14. SITE DRAINAGE, PUMPING, STORM WATER MANAGEMENT

A. Site Drainage – The General Contractor shall take over the responsibility for site drainage upon entering the premises and shall maintain such drainage during the term of all Prime Contracts in a manner approved by the Owner’s Representative and so as
not to adversely affect the construction, the building during various stages and the adjacent areas.

B. **Pumping** – The General Contractor shall, during the progress of the work of all Prime Contracts, provide and maintain all required pumps, suction and discharge lines, power, etc., in sufficient number, capacity, and configurations to keep all excavations, pits, trenches, footings, foundations, and the entire property area free from accumulation of water from any source whatsoever, and also keep the Project dry and free of water, at all times and under any and all circumstances and contingencies that may arise.


D. Contractor shall pay Owner for any costs Owner incurs based on Contractor’s non-compliance with this Section, including but not limited to repair or remediation costs, fines or penalties imposed on Owner by any regulating authority, and any fees or costs paid to attorneys or consultants arising out of a prohibited stormwater discharge.

15. **WASTE DISPOSAL AND ASBESTOS HANDLING**

| A. **Waste Disposal** – The Contractor shall be responsible for disposal, recycling or reclamation of all solid or hazardous waste generated by its performance of the Work. The Contractor shall comply with all applicable state and federal regulations in handling, storing, transporting and disposing of solid or hazardous waste. |

| 1. The Contractor acknowledges its recognition and understanding that “clean fill” is defined by 329 IAC 12-3-1(1) to consist only of uncontaminated rocks, brick, concrete, road demolition waste materials or dirt, and expressly does not include painted material and treated wood. Contractor shall dispose of any waste that contains painted materials and treated wood as solid waste. |

| 2. Prior to the removal from the site of any solid waste or clean fill, the Contractor shall inform the Owner’s Representative of the intended disposal site for the material. The Owner has the right, but not the responsibility, to reject a site as suitable for the disposal of the material, and the Contractor shall bear any cost or expense associated with identifying an appropriate alternative disposal site. |

| 3. The Contractor shall provide the Owner’s Representative with a copy of all transport and material acceptance documents related to the disposal of solid |
waste or clean fill, such as tare weights and bills of lading, upon receipt by the Contractor.

4. Within 10 days of shipment off-site of any hazardous waste, the Contractor shall provide the Owner’s Representative with a copy of all hazardous waste manifests. The Contractor shall provide Owner’s Representative with a copy of the manifest signed by the TSD (Treatment Storage and Disposal) company within 10 days of receipt by the Contractor.

B. Asbestos Handling – Contractor is expected to be familiar with the appearance and likely locations of asbestos and asbestos containing materials (“ACM”), even if demolition and/or asbestos abatement is not a contracted-for part of the Work.

1. Technical specifications prepared by the Owner or the Owner’s Representative may identify the nature and extent of asbestos to the extent known at the time of issuance of the specifications, but site conditions as of the time of the preparation of specifications may prevent complete and accurate identification the exact nature and extent of asbestos or ACM at the Project site.

2. Contractor may encounter asbestos or ACM during the course of the work. In the event that Contractor observes material that is suspected to be asbestos or ACM, Contractor shall stop work immediately and notify the Owner’s Representative, who shall direct next steps in terms of testing, removal and disposal. If the suspicious material is determined to be asbestos or ACM, Contractor may be directed to undertake the removal and disposal of the material by way of a Construction Change Directive or, at the Owner’s discretion, a third party may be hired to undertake this work.

C. Contractor shall pay Owner for any costs Owner incurs based on Contractor’s non-compliance with this Section, including but not limited to repair or remediation costs, fines or penalties imposed on Owner by any regulating authority, and any fees or costs paid to attorneys or consultants arising out of a prohibited storm water discharge or improper disposal of solid or hazardous waste, including but not limited to asbestos or ACM.

16. MANDATORY ENVIRONMENTAL HEALTH AND SAFETY TRAINING

The Contractor shall ensure that appropriate personnel, preferably at least two, attend and participate in Environmental Health and Safety training conducted through the Owner’s Office of Environmental Health & Safety. The Assistant Director of Environmental Health & Safety at IUPUI coordinates this training for projects on all campuses, and the Contractor should call 317-274-2829 to schedule this mandatory training.

17. TEMPORARY ACCESS TO SITE AND PARKING
A. Existing Roadways, Temporary Roadways

1. Access to the project site shall be identified on a per project basis.

2. As required, the Contractor shall provide access to the building by temporary roads and walks in the area indicated by the Owner. The Contractor shall maintain the temporary roads and walks in continuous serviceable and clean condition throughout the course of the project. The main roads must remain open to vehicle and pedestrian traffic at all times. Materials so used for the temporary roads and walks shall be removed from the site, and the location of same shall revert to the schedule of construction in such a manner as may provide for completion of the work on schedule, unless same are a portion of the permanent construction and completed later.

3. The Contractor shall keep adjacent city streets free from mud or debris deposited thereon as a result of operations under this Contract. Contractor shall maintain and restore such streets to their original condition.

B. Parking

1. Owner shall either identify parking facilities that may be used by the Contractor for its equipment, personnel, and workmen or shall notify Contractor that is no project-related parking available on University property.

2. In general, parking of cars shall be restricted to the limits of the site or on streets where public parking is permitted. Parking of cars will not be permitted on other parking lots, drives or roads of academic or residential buildings.

3. On IUPUI projects, free shuttle service is provided from the designated Contractor parking area at 1302 N. Indiana Avenue. Contractors are prohibited from parking in any IUPUI campus visitor facility.

4. On Bloomington projects, Contractor’s employees are to park at the Purple Lot at the Athletics complex. A fee for parking at this lot will be charged to Contractor. Unless otherwise agreed by the parties, Contractor is responsible for transporting its employees from the Purple Lot to the jobsite.

5. On projects at all other campuses, free parking areas will be designated for Contractor’s employees and hang tags will be provided to Contractor by campus parking operations.
SECTION 011000 - SUMMARY

PART 1 - GENERAL

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

1.2 SUMMARY
   A. Section Includes:
      1. Project information.
      2. Work covered by Contract Documents.
      3. Access to site.
      4. Coordination with occupants.
      5. Work restrictions.
   B. Related Requirements:
      1. Division 00 Section “Special Conditions”
      2. Division 01 Section "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.3 PROJECT INFORMATION
   A. Project Identification: Swain West - Room 055 Renovation– IU # 20142395.
      1. Project Location: 727 East 3rd Street, Bloomington IN, 47405
      2. Project major scope includes Room 055 new casework, equipment platform, fill in concrete slab pit, seal concrete floor, patch wall & paint. Room 056-new fume hood. Mechanical, electrical and plumbing work.
   B. Owner: The Trustees of Indiana University
      1. Owner's Representative/architect:
         a. Somsri Bond, IU University Architects Office
            1800 N. Range Road, Bloomington IN, 47408
            Ph. 812.856.6746
         b. Kyle Jewart, CM, IU University Architects Office
            1800 N. Range Road, Bloomington IN, 47408
            Ph. 812.855.9234
      2. Consultant MEP Engineers: Ross & Baruzzini
         a. Garrett Mize, mechanical engineer
            Ph. 317.638.8383
         b. Jeff Brown, electrical engineer
            Ph. 317.638.8383
      3. Building Manager:
         a. David Sprinkle,
            Ph. 812-855-0347
1.4 ACCESS TO SITE
   A. General: Contractor shall have limited use of Project site for construction operations as indicated by requirements of this Section.
   B. Use of Site: Limit use of Project site to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
      1. Limits: Confine construction operations to areas indicated on plan.
      2. Driveways, Walkways and Entrances: Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
         a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
         b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
   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.

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. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and authorities having jurisdiction.
      2. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.

1.6 WORK RESTRICTIONS
   A. Work Restrictions, General: Comply with restrictions on construction operations.
      1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.
   B. 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 two days in advance of proposed utility interruptions.
      2. Obtain Owner's written permission before proceeding with utility interruptions.
   C. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.
      1. Notify Owner not less than two days in advance of proposed disruptive operations.
      2. Obtain Owner's written permission before proceeding with disruptive operations.
   D. Nonsmoking Building: Smoking is not permitted within the building or within 8 m (25 feet) of entrances, operable windows, or outdoor-air intakes.
   E. Controlled Substances: Use of tobacco products and other controlled substances on Project site is not permitted.
   F. Employee Screening: Comply with Owner's requirements for drug and background screening of Contractor personnel working on Project site.
      1. Maintain list of approved screened personnel with Owner's representative.
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. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

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

C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
   1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
   2. Abbreviations: Materials and products are identified by abbreviations published as part of the U.S. National CAD Standard and scheduled on Drawings.
   3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000
SECTION 03 30 53 - MISCELLANEOUS CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

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

1.2 SUBMITTALS
A. Product Data: For each type of product indicated.
B. Other Action Submittal:
   1. Design Mixtures: For each concrete mixture.

1.3 QUALITY ASSURANCE
A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
B. Comply with ACI 301 (ACI 301M).
C. Comply with ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

PART 2 - PRODUCTS

2.1 FORMWORK
A. Furnish formwork and formwork accessories according to ACI 301 (ACI 301M).

2.2 CONCRETE MATERIALS
A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source throughout Project:
   1. Portland Cement: ASTM C 150, Type I.
      a. Fly Ash: ASTM C 618, Class C or F.
      b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
   B. Normal-Weight Aggregate: ASTM C 33, graded, 1-1/2-inch (38-mm) nominal maximum aggregate size.
   C. Water: ASTM C 94/C 94M.

2.3 ADMIXTURES
B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will 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 C 494/C 494M, Type A.
   2. Retarding Admixture: ASTM C 494/C 494M, Type B.
   3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
   4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
   5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
   6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
2.4 RELATED MATERIALS
   A. Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber, or ASTM D 1752, cork or self-expanding cork.

2.5 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 C 171, polyethylene film or white burlap-polyethylene sheet.
   D. Water: Potable.
   E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.
   F. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

2.6 CONCRETE MIXTURES
   A. Normal-Weight Concrete: Prepare design mixes, proportioned according to ACI 301 (ACI 301M), as follows:
      1. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
      2. Maximum Water-Cementitious Materials Ratio: 0.45.
      3. Cementitious Materials: Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.
      4. Slump Limit: 5 inches (125 mm), 8 inches (200 mm) for concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch (25 mm).
      5. Air Content: Maintain within range permitted by ACI 301 (ACI 301M). Do not allow air content of trowel-finished floor slabs to exceed 3 percent.

2.7 CONCRETE MIXING
   A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.
      1. When air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK
   A. Design, construct, erect, brace, and maintain formwork according to ACI 301 (ACI 301M).

3.2 EMBEDDED ITEMS
   A. Place and secure anchorage devices and other embedded items required for adjoining work 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 JOINTS
   A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
   B. Contraction Joints in Slabs-on-Grade: Form weakened-plane sawed contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness.
   C. Isolation Joints: Install joint-filler strips at junctions with slabs-on-grade and vertical surfaces,
such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint fillers full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.

3.4 CONCRETE PLACEMENT
A. Comply with ACI 301 (ACI 301M) for placing concrete.
B. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301 (ACI 301M).
C. Do not add water to concrete during delivery, at Project site, or during placement.
D. Consolidate concrete with mechanical vibrating equipment.

3.5 FINISHING FORMED SURFACES
A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defective areas repaired and patched. Remove fins and other projections exceeding 1/2 inch (13 mm).
   1. Apply to concrete surfaces not exposed to public view.
B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defective areas. Remove fins and other projections exceeding 1/8 inch (3 mm).
   1. Apply to concrete surfaces exposed to public view.
C. Rubbed Finish: Apply the following rubbed finish, defined in ACI 301 (ACI 301M), to smooth-formed finished as-cast concrete where indicated:
   1. Smooth-rubbed finish.
D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.6 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. Screed surfaces with a straightedge and strike off. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane before excess moisture or bleedwater appears on surface.
   1. Do not further disturb surfaces before starting finishing operations.
C. Scratch Finish: Apply scratch finish to surfaces indicated and surfaces to receive concrete floor topping or mortar setting beds for ceramic or quarry tile, portland cement terrazzo, and other bonded cementitious floor finishes, unless otherwise indicated.
D. Float Finish: Apply float finish to surfaces indicated, to surfaces to receive trowel finish, and to floor and slab surfaces to be covered with fluid-applied or sheet waterproofing, fluid-applied or direct-to-deck-applied membrane roofing, or sand-bed terrazzo.
E. 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.
F. Trowel and Fine-Broom Finish: Apply a partial trowel finish, stopping after second troweling, to surfaces indicated and to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set methods. Immediately after second troweling, and when concrete is still plastic, slightly scarify surface with a fine broom.
G. Nonlip Broom Finish: Apply a nonlip broom finish to surfaces indicated and to exterior concrete platforms, steps, and ramps. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.
3.7 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 301 (ACI 301M) 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 (1 kg/sq. m 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 (300-mm) 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 (300 mm), 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.

3.8 FIELD QUALITY CONTROL
A. Testing Agency: Contractor will engage a qualified testing agency to perform tests and inspections.
B. Tests: Perform according to ACI 301 (ACI 301M).
   1. Testing Frequency: One composite sample shall be obtained for each day's pour of each concrete mix exceeding 5 cu. yd. (4 cu. m) but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.

3.9 REPAIRS
A. Remove and replace concrete that does not comply with requirements in this Section.

END OF SECTION 03 30 53
SECTION 05 50 00 — METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Furnish and install all miscellaneous iron, steel, and aluminum items not specifically described in other Sections of these Specifications but required for a complete and operable facility as indicated or implied by the Contract Documents.
2. Provide the following items:
   a. Steel framing and connectors for suspended platform.
3. All items indicated to be shop finished, shop and field painted.

B. Related Sections:

1. Division 09 Section “Painting”

1.2 SUBMITTALS

A. Product Data:

1. Furnish manufacturers product data, load, testing

B. Shop Drawings:

1. Before any metal is fabricated, submit complete shop and setting Drawings for review.
2. Indicate all locations, markings, quantities, materials, sizes, shapes, finish, dimensions, methods of connection, anchoring, fastening, bracing, and attachment to work of other trades.

C. Conflicting Requirements:

1. In the event of conflict between pertinent codes and regulations and the requirements of the referenced standards or these Specifications, the provisions of the more stringent shall govern.

1.3 PRODUCT HANDLING

A. Coordination:
1. Schedule deliveries of fabrications to ensure timely completion of the Work.

B. Dissimilar Metals:

1. Isolate dissimilar metals using neoprene pads, spacers, or gaskets.
2. Asphaltic or bituminous paints may be used in certain installations of dissimilar metals.
   a. Thickness of paint film shall be 10 mil, minimum.

1.4 FIELD MEASUREMENT

A. Obtain all necessary field measurements to accurately fit this Work with the Work of others.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces without blemishes.

2.2 EQUIPMENT SUPPORTS

A. Framework:

1. Manufacturers:
   a. Unistrut Corporation (Optional)
   b. Powerstrut
   c. Hilti USA
2. Sizes as shown on drawings or required to support loads indicated.
3. Provide nuts, bolts, general fittings, and accessories as required for complete installation.
4. Finish shall be equal to Unistrut Greenamel.
5. System shall limit deflection as required by the manufacturer of the equipment being supported. If not indicated by manufacture, limit deflection to L/240.

B. Bolts And Nuts:

1. All bolts and nuts for use with steel shapes and miscellaneous uses shall conform to ASTM A325.

C. Anchors:

1. Basis-of-Design Product: The design for anchors is based on products manufactured by Hilti, Inc. or ITW Ramset Red Head. Products incorporated in the work shall have equivalent allowable tension and shear load values as the basis-of-design product in the substrate indicated. Alternative diameters and embedment depths may be used, subject to
Architect/Engineer approval. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:

a. Hilti, Inc.
b. ITW Ramset/Red Head, division of Illinois Toolworks
c. Powers Fasteners

2. Bolts Into Concrete:

a. Expansion anchor:
   1) Hilti HSL Expansion Anchor; Hilti Fastening Systems
   2) Trubolt Wedge; ITW Ramset/Red Head

b. Self-drilling anchors
   1) Self-Drill Anchor; ITW Ramset/Red Head

c. Sleeve anchors:
   1) Hilti Sleeve Anchors; Hilti Fastening Systems
   2) Dynabolt Sleeve; ITW Ramset/Red Head

D. Welding Electrodes:

1. Arc welding electrodes used shall be only those specifically recommended by the American Welding Society for the purpose indicated.

2.3 STEEL ANGLES

A. Provide steel angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work.

2.4 OTHER MATERIALS

A. All other materials, not specifically described but required for a complete and proper installation of miscellaneous metal, shall be new, free from rust, best quality of their respective kind, and subject to review by the Architect/Engineer

2.5 STEEL AND IRON FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Finish metal fabrications after assembly.

B. Shop prime iron and steel items.

1. Shop prime with universal shop primer unless zinc-rich primer is indicated.
2. The products of Pratt & Lambert are referenced for standardization.
3. All primer paint shall be compatible with the finish coat specified in Division 09.

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 FABRICATION
   A. Prefabrication:
      1. Insofar as possible, shop fabricate and shop weld all items complete and ready for installation.
   B. Verifying Conditions:
      1. Where metal fabrication items will be used for attachment or support of manufactured equipment, consult appropriate manufacturers and verify that details indicated on the drawings will properly receive and support their equipment.

3.2 WELDING
   A. Shop weld all connections unless otherwise indicated.
   B. Make all joints and intersections of metal tightly fitting and securely fastened. Make all work square, plumb, straight and true.
   C. Dress and finish welds to blend into parent metal.

3.3 HOLES
   A. Coordinate location of holes required for Work provided by others.
   B. Drill or punch all holes required for the attachment of Work of other trades for bolted connections.
      1. Burned holes are not acceptable.
   C. Provide tapped holes of size and thread necessary to receive other Work.
3.4 FINISHING

A. Prepare and Shop prime paint metal fabrications unless otherwise indicated to be unfinished.
   1. Coordinate preparation and application of primers with Work under Division 09 Section “Painting”.

B. Shop finish metal fabrications indicated to receive finish under this section.
   1. Finish metal fabrications after fabrication is complete, or in sections fabricated to the greatest extent possible.
   2. For fabrications requiring field assembly, provide for field finishing where welding is required and for restoration of damaged finishes to minimize differences in appearance between shop finish and field finish.

3.5 INSTALLATION

A. Coordination:
   1. All such items shall be completely fabricated, complete with bolts, anchors, clips, etc., ready to set, and be delivered to the general locations in the Work.
   2. Make delivery to points to expedite the installation of delivered materials in their correct locations.

B. Isolation:
   1. Isolate dissimilar materials using neoprene washers, spacers, gaskets, or other approved materials.
   2. Isolate aluminum materials from cement or concrete with asphaltic paint or other permanent coating acceptable to manufacturer.

C. Anchors And Connections:
   1. Where necessary to secure steel and iron work to the structure by means of expansion bolts, cinch anchors, or similar connections, lay out and install such connections. Install miscellaneous iron work and secure.

3.6 REPAIR AND RESTORATION

A. Repair, repaint or restore finished items damaged before or during installation to match the original finish.

END OF SECTION 05 55 00
SECTION 079200 –JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY
   A. Section Includes:
      1. Silicone joint sealants.

1.2 ACTION SUBMITTALS
   A. Product Data: For each joint-sealant product indicated.

1.3 INFORMATIONAL SUBMITTALS
   A. Product test reports.
   B. Warranties.

1.4 QUALITY ASSURANCE
   A. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.

1.5 WARRANTY
   A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
      1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL
   A. Low-Emitting Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the testing and product requirements of the California Department of Health Services’ "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
   B. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
1. Suitability for Immersion in Liquids. Where sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247. Liquid used for testing sealants is deionized water, unless otherwise indicated.

C. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

2.2 SILICONE JOINT SEALANTS

A. Neutral-Curing Silicone Joint Sealant: ASTM C 920.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. BASF Building Systems.
   b. Dow Corning Corporation.
   c. GE Advanced Materials - Silicones.
   d. May National Associates, Inc.
   e. Pecora Corporation.
   f. Polymeric Systems, Inc.
   g. Schnee-Morehead, Inc.
   h. Sika Corporation; Construction Products Division.
   i. Tremco Incorporated.

2. Type: Single component (S) or multicomponent (M).
3. Grade: nonsag (NS).
4. Class: 100/50.
5. Uses Related to Exposure: Traffic and Nontraffic.

2.3 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.
1. Remove laitance and form-release agents from concrete.
2. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.2 INSTALLATION

A. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

B. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

C. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.

F. Acoustical Sealant Installation: Comply with ASTM C 919 and with manufacturer's written recommendations.
G. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.
1.

END OF SECTION 079200
SECTION 09 91 00 — PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Furnish all painting materials and accessories. Prepare, paint, or finish surfaces, including, but not limited to, the following:

   a. Exposed concrete deck, CMU wall, door frames, platform metal framing and bulkheads as indicated on the drawings and where cutting and patching has been performed.
   b. Existing painted surfaces as noted on drawings and where cutting and patching has been performed.

B. Related Sections:

   1. Division 05 Section Metal

1.2 DEFINITIONS

A. Finish sheen definitions:

1. Flat: Lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
2. Eggshell: Low-sheen finish with a gloss range between 5 and 20 when measured at a 60-degree meter.
3. Satin: Low-sheen finish with a gloss range between 15 and 35 when measured at a 60-degree meter.
4. Semi-gloss: Medium-sheen finish with a gloss range between 30 and 65 when measured at a 60-degree meter.
5. High- or Full- Gloss: High-sheen finish with a gloss range more than 65 when measured at a 60-degree meter.

B. Interior: In a conditioned space.

1.3 SUBMITTALS

A. Product Data:

1. Submit brochures describing products, preparation requirements, coverage rates, and maintenance procedures.

   a. Indicate compliance with U.S. Federal regulations regarding lead and zinc content.
2. Submit manufacturer’s certification or comparison chart indicating that material submitted is equivalent to the system materials specified.
   a. For products listed on the Master Painters Institute (MPI) Approved Products List, indicate product type and include a copy of the product listing.


B. Samples:
   1. Submit full range of standard and custom colors for each system.
   2. Paint samples: Provide actual samples of selected finish color on white card stock, minimum 4 inches by 8 inches.

1.4 QUALITY ASSURANCE

A. Single-Source responsibility: Materials selected for each coating system and type of surface shall be the product of a single manufacturer.

B. Material Compatibility:
   1. Primers shall be the same manufacturer as the paint used for the final coats and shall be of the type recommended by that manufacturer for the particular application.
   2. Thinners, when used, shall be only those thinners recommended for that purpose by the manufacturer of the material to be thinned.

C. Volatile Organic Compound (VOC) content: Materials shall conform to current federal requirements for content of lead, zinc and volatile organic compounds (VOC’s).
   1. Low Odor / Low- VOC paints: paints shall meet or exceed the criteria of Green Seal Standard GS-11, less water, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   2. VOC Limits for architectural paints, coatings and primers applied on the interior of the building: Use materials that do not exceed the VOC content limits established in Green Seal Standard GS-11, less water, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
      a. Flats: 50 g/L
      b. Non-flats: 150 g/L
   3. VOC Limits for anti-corrosive and anti-rust paints applied to interior ferrous substrates: Use materials that do not exceed the VOC content limit of 250 g/L established in Green Seal Standard GC-03, less water.
   4. VOC Limits for clear wood finishes, floor coatings, stains and shellacs: Use materials that comply with California South Coast Air Quality Management District (SCAQMD) Rule #1113 limits for VOC content, calculated in accordance with Rule #1113, less water and exempt compounds:
      a. Clear wood finishes: Varnish, 350 g/L; Lacquer 550 g/L
b. Sealers:
   1) Waterproofing sealers: 250 g/L
   2) Sanding sealers: 275 g/L
   3) All other sealers: 200 g/L

c. Shellacs: Clear, 730 g/L; pigmented 550 g/L

d. Stains: 250 g/L

1.5 DELIVERY, STORAGE, AND HANDLING

A. Delivery:
   1. Deliver all paint materials to the job site in their original unopened containers with all
      labels intact and legible at time of use.

B. Storage and handling:
   1. Store only the approved materials at the job site and store only in a single designated area
      restricted to the storage of paint materials and related equipment.
   2. All paints, varnishes, and volatile oil shall be stored in accordance with health, safety,
      and fire regulations.
   3. Storage area shall be kept clean. Oily rags, waste material, empty cans, etc. shall be
      removed each day.
   4. “No Smoking” signs and covered waste receptacles shall be provided in the area.
   5. Floor of storage area shall be covered and protected from spilled material.
   6. Provide metal lockers for storage and provide two listed 2A:20BC rated multi-purpose
      dry chemical or a 10BC rated CO² fire extinguisher mounted in the immediate area.
   7. Use all means necessary to protect paint materials before, during, and after application
      and to protect the installed Work and materials of all other trades.
   8. Use fire-retardant treated drop cloths where flammable products are in use.

1.6 SITE CONDITIONS

A. Do not clean, prepare or paint surfaces on which condensation is evident or when environmental
   conditions may cause condensation to form on surfaces during finishing operations.

B. Maintain temperature and humidity levels during finishing work at a level to prevent
   condensation.

C. Apply paints and finish product within the temperature range acceptable to the manufacturer of
   the product, as listed on the product label or product data sheet.
PART 2 - PRODUCTS

2.1 LIQUID APPLIED PAINTS, STAINS AND FINISH COATS

A. Acceptable Manufacturer: The Sherwin Williams Company
   1. Indiana University has developed a purchasing contract with Sherwin-Williams. All projects, at all campuses, shall use Sherwin-Williams products. All contractors bidding on work for Indiana University shall contact their local Sherwin-Williams store to receive Indiana University negotiated pricing on paint and related products. Identify all projects by Project Name and Project Number when purchasing or receiving quotations for projects.

B. General:
   1. There is no attempt to define the physical properties and composition of the painting materials. Furnished product shall be the manufacturer’s equivalent to those specified.
   2. Provide primer and topcoat listed by the manufacturer as compatible with the substrate indicated.
      a. Where conflict arises between manufacturer’s printed application recommendation and scheduled product listing, the manufacturer’s recommendations shall prevail, maintaining carrier type and gloss level indicated.
   3. Prime walls scheduled to receive wallcoverings, using primer indicated on Painting Schedule for substrate, unless noted otherwise.

C. Color Standard:
   1. Colors shall match color selections indicated on the Finish Schedule
   2. The use of paint manufacturer names in the Drawing Schedule “Finish Specifications” are for color selection only, and do not indicate selection of a particular manufacturer’s products.

PART 3 - EXECUTION

3.1 PREPARATION OF SURFACES, GENERAL

A. Protection:
   1. Prior to all surface preparation and painting operations, completely mask, remove, or otherwise adequately protect all hardware, accessories, machined surfaces, nameplates, tags on fire-rated doors and frames, lighting fixtures, and similar items in contact with painted surfaces but not scheduled to receive paint.

B. Cleaning:
1. Before applying paint or other surface treatment, thoroughly clean all surfaces involved.
   a. Use cleaning methods and materials that limit the potential to contaminate or damage other surfaces. Remove and/or neutralize cleaning solutions in accordance with cleaning agent manufacturer’s recommendations and local environmental regulations.

2. Schedule all cleaning and painting so that dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces or other finished surfaces.

C. Priming:
   1. Spot prime all exposed nails and other metals that are to be painted with emulsion paints using a primer recommended by the manufacturer of the coating systems.
   2. Primer is not required at new gypsum drywall that has received primer/surfacer, unless required by manufacturer of finish coating.

3.2 PREPARATION OF WOOD SURFACES

A. Smoothing:
   1. Unless specifically noted to be rough, smooth all finished wood surfaces exposed to view using graded sandpaper, successively from coarse to fine grades.
      a. Painted wood: minimum 150 grit
      b. Stained wood: minimum 220 grit

B. Knots:
   1. On small, dry, seasoned knots, thoroughly scrape and clean the surface and apply one coat of good quality knot-sealer before application of the priming coat or stain.

C. Moisture content:
   1. Do not proceed with the painting of wood surfaces until the moisture content of the wood is 12 percent or less.

3.3 PREPARATION OF METAL SURFACES

A. Clean metal using chemical or mechanical methods recommended by the finish coat manufacturer for the metal substrate indicated.
   1. Clean metal deck indicated to receive paint or fireproofing using SSPC SP-1 methods approved by deck manufacturer to remove surface oils and other contaminants detrimental to paint or fireproofing adhesion.
   2. Clean structural steel and steel trusses and open-web joists indicated to receive finish paint using SSPC SP-1 methods approved by coating manufacturer to remove dirt, surface oils and other contaminants detrimental to paint or fireproofing adhesion.
B. Where recommended, pretreat metal using chemical methods recommended by the finish manufacturer.

1. General:
   a. Apply, remove and dispose of chemical solutions in accordance with State and local environmental regulations.
   b. If treatment is performed at the project site, protect surrounding surfaces from contamination or detrimental effects from treatment chemicals.
   c. Clean, repair or replace, as required, materials damaged during metal pretreatment.

2. Galvanized metal:
   a. Clean all surfaces thoroughly with solvent until they are completely free from dirt, oil, and grease.
   b. Thoroughly treat the cleaned surface with phosphoric acid etch.
   c. Remove all excess etching solution and dry completely before application of paint.

C. Other metals:

1. Thoroughly clean all surfaces until they are completely free from dirt, oil, and grease.
2. Allow to dry thoroughly before application of paint.

D. Touch up damaged primer on items delivered with shop or prime coats, before application of finish coat. Touch-up with same material as shop primer.

3.4 PREPARATION OF GYPSUM DRYWALL

A. Coordination:

1. Ensure that dirt, dust, and other foreign matter have been removed. Ensure that all apparent deposits of spackling compound have been removed, taking care not to damage the paper cover of the gypsum drywall.
2. Spackle and lightly sandpaper scuffs, scratches, and nicks.

3.5 PREPARATION OF EXISTING PAINTED SURFACES

A. Preparation

1. Remove dust, dirt, powdery residue, grease, oil, wax, or other contaminates.
2. Remove flaking or peeling paint and correct all defects.
3. Dull glossy old paints by light sanding.
4. Patch cracks and holes, sand smooth, and spot prime prior to finishing.
5. Feather edges at surface repairs.
3.6 FINISH APPLICATION

A. General:

1. Paint all surfaces, except glass and similar items not finished and not called out as unfinished.
   a. Operating Parts: Do not paint moving parts of operating units, mechanical and electrical parts, such as valve and damper operators, linkages, sinkages, sensing devices, motor and fan shafts, and sprinkler heads, unless otherwise specified.

2. Paint all grilles and other pre-finished items where the factory finish is not in accordance with the “Painting Schedule” and color selection.

3. Allow 48 hours drying time before recoating. Modify the periods as recommended by the material manufacturer to suit adverse weather conditions.

4. Suction and hot spots shall be touched up after first coat has been applied.

5. Where preceding coat is not completely covered by finish coat or does not adequately hide underlying finishes or marks, apply additional coats at no additional cost to the Owner.

6. Finish coats shall be smooth and uniform, completely hiding undercoats.

7. Edges adjoining different colors or materials shall be sharp and clean with no overlap.

8. Touch-up or repainting of surfaces shall cover entire item, frame, or wall area. “Spot” touch-up work will not be permitted.

9. The Contractor shall use the primer best suited for the paint products scheduled under Part 3 of this Section, and for compatibility with the substrate.

10. Apply appropriate fire-retardant coating to items indicated to receive “fire retardant paint” or “fire retardant varnish”.

B. Environmental conditions:

1. Do not apply paint in areas where dust is being generated.

2. Turpentine shall not be used in closed areas.

3. Temperature shall be maintained above 50˚F at all times.

C. Defects:

1. Repair or fill defects between coats with appropriate fill material.

2. Sand and dust between coats to remove all defects visible to the unaided eye from a distance of five feet.

D. Color of undercoats:

1. Each coat of paint shall be slightly darker than the preceding coat with all coats tinted toward the finish coat color.
   a.
3.7 FIELD QUALITY CONTROL

A. General:

1. Dry film thickness (DFT): Per manufacturer’s printed recommendations and total not less than thickness indicated in manufacturer’s written application instructions.

3.8 REINSTALLATION OF REMOVED ITEMS

A. Following completion of painting in each space, promptly reinstall all items removed for painting, using only workmen skilled in the particular trade.

3.9 CLEANING

A. General:

1. Prevent accidental spilling of paint materials. In the event of such spill, immediately remove all spilled material and the waste or other equipment used to clean up the spill, and wash the surface to its original undamaged condition, at no additional cost to the Owner.

B. Prior to final inspection:

1. Upon completion of this portion of the Work, visually inspect all surfaces and remove all paint and traces of paint from surfaces not scheduled to be painted.

3.10 PAINTING SCHEDULE - GENERAL

A. The products of The Sherwin Williams Company are used in this schedule, unless otherwise noted.

B. Color selection:

1. Match color indicated on the Finish Schedule.

C. Existing painted surfaces to be repainted:

1. A prime coat is not required if existing finish coverage is adequate, adhesion to the existing surface can be obtained without a primer or deglosser, and direct application without primer is permitted in the manufacturer’s written instructions.

2. The Contractor shall use the primer or surface treatment required to ensure a compatibility with both the existing surface and the new paint being used.

3. New paint finishes shall match existing adjacent finishes unless indicated otherwise.

D. Interior:

1. Concrete Masonry Units:
a. 1 coat primer: Sherwin Williams Loxon Block Surfacer A24W200  
b. 2 coats interior semi-gloss latex: Sherwin Williams Harmony Semi-Gloss B10 Series

2. Gypsum Wallboard  
a. 1 coat primer: Sherwin Williams ProMar 200 Interior Latex Primer B28W200 Series 
b. 2 coats interior flat latex: Sherwin Williams ProMar 200 Interior Latex Flat

3. Ferrous Metals:  
a. 1 coat primer: Sherwin Williams Procryl Acrylic Primer/Finish B66W1 
b. 2 coats enamel: Sherwin Williams ProMar 200 Interior Alkyd Semi-Gloss

4. Galvanized Metals:  
a. 1 coat primer: Sherwin Williams DTM Acrylic Primer/Finish B66W1 
b. 2 coats enamel: Sherwin Williams Pro Classic Waterborne Interior Acrylic Semi-Gloss Enamel B31 Series

END OF SECTION 09 91 00
SECTION 115313 LABORATORY FUME HOOD

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. Bench-top laboratory fume hoods.
2. Manufacturer installed piping and wiring within fume hoods for service fittings, light fixtures, fan switches, and other electrical devices included with fume hoods.
4. Work tops within fume hoods.
5. Cup sinks in fume hoods.
6. Water, laboratory air, gas, and electrical service fittings in fume hoods.

B. Products whose Installation must be coordinated with:

1. Laboratory fume hood certification and testing.

C. Related Requirements:

1. Division 22 – Plumbing sections for sanitary waste, water, laboratory air and gas, water connections.
2. Division 23- "Testing, Adjusting, and Balancing" for field quality-control testing of fume hoods.
3. Coordinate with IU Control for installation of local alarm. (IU provide/install control)

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For laboratory fume hoods.

1. Include plans, elevations, sections, and attachment details.
2. Indicate locations and types of service fittings together with associated service point of connection and type of supply connection required. Provide data indicating compliance DIN 12920 or EN 13792 for color coding of service fittings.
3. Indicate duct connections, electrical service point of connection, and locations of access panels.
4. Include roughing-in information for mechanical, plumbing, and electrical services.

C. Information for Operation and Maintenance Manuals: Written instruction manuals outlining safe operating procedures, safety guidelines, and proper periodic maintenance procedures.

D. Delegated-Design Submittal: For fume hoods indicated to comply with seismic performance requirements and design criteria.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Showing compliance with specified performance requirements for as-manufactured containment and static pressure loss, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency.

B. Source quality-control reports.

C. Field quality-control reports verifying conformance to ANSI/ASHRAE Standard 110.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish complete touchup kit for each type and color of fume hood finish provided. Include fillers, primers, paints, and other materials necessary to perform permanent repairs to damaged fume hood finish.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect finished surfaces during handling and installation with protective covering of polyethylene film or another suitable material.

1.7 FIELD CONDITIONS

A. Verify Existing Conditions

B. Locate concealed framing, blocking, and reinforcements that support fume hoods by field measurements before being enclosed, and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Constant Volume Fume Hood and Steel Exterior:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2.2 Source Limitations: Obtain laboratory fume hoods from single manufacturer.

A. Product Designations: Drawings indicate sizes, types, and configurations of fume hoods by referencing designated manufacturer's catalog numbers. Other manufacturers' fume hoods of similar sizes, types, and configurations, and complying with the Specifications, may be considered. See Section 016000 "Product Requirements."

2.3 PERFORMANCE REQUIREMENTS

A. Fume hood construction, design and performance: Provide fume hoods that comply with UL 1805.

1. Proper labeling must be affixed to each fume hood indicating classification to the UL 1805 standard for Laboratory fume hoods.

B. Containment: Provide fume hoods that comply with the following when tested according to ASHRAE 110, Method of Testing Performance of Laboratory Fume Hoods and as indicated below:

1. As-Manufactured (AM) Rating: AM 0.05 (0.05 ppm).
2. As-Installed (AI) Rating: AI 0.10 (0.10 ppm).
3. Average Face Velocity: 100 fps (0.51 m/s) plus or minus 10 percent with horizontal sash opening open for full width and 18 inches in height. 80 fps (0.41 m/s) plus or minus 15 percent with horizontal sash fully open.
4. Face-Velocity Variation: At any designated measuring point, not more than 20 percent of average face velocity across the face opening with sashes fully open.

C. All fume hoods shall be constructed to the standards of SEFA Recommended Practice 1-2010 Fume Hoods.

1. Sash Position:
   a. Test hoods with combination sashes fully raised, with maximum opening on one side, with maximum opening in the center, and with one opening at each side equal to half of maximum opening.
2. Minimum exhaust airflow (sash in closed position) shall provide 150 air changes per hour within the fume hood.
3. Noise Criteria Rating: Provide fume hoods with NC rating equal to or less than 50 when measured 36 inches (mm) in front of hood, with sash open for full width and 18 inches in height.
4. Release Rate: 4.0 L/min.
D. Static-Pressure Loss: Not more than .15 inch wg (Pa) at 100 fpm (0.51-m/s face velocity with sash fully open when measured at four locations 90 degrees apart around the exhaust duct and at least three duct diameters downstream from duct collar.

2.4 FUME HOODS

A. Product Standards: Comply with SEFA 1, "Laboratory Fume Hoods - Recommended Practices." Provide fume hoods UL listed and labeled for compliance with UL 1805.

1. Provide pre-wired and pre-piped assembly.

B. Constant-Volume Fume Hood: Provide constant-volume fume hood open bypass.

2.5 MATERIALS

A. Steel Sheet: Cold-rolled, commercial steel (CS) sheet, complying with ASTM A 1008/A 1008M; matte finish; suitable for exposed applications.

B. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304, stretcher-leveled standard of flatness.

C. Glass-Fiber-Reinforced Polyester: Polyester laminate with a chemical-resistant gel coat on exposed faces, and having a flame-spread index of 25 or less according to ASTM E 84.

D. Epoxy: Factory molded, modified epoxy-resin formulation with smooth, nonspecular finish.

1. Physical Properties:

   a. Flexural Strength: Not less than 70 MPa (10,000 psi).
   b. Modulus of Elasticity: Not less than 1400 MPa (2,000,000 psi).
   c. Hardness (Rockwell M): Not less than 100.
   d. Water Absorption (24 Hours): Not more than 0.02 percent.
   e. Heat Distortion Point: Not less than 127 deg C (260 deg F).
   f. Flame-Spread Index: 25 or less according to ASTM E 84.

2. Chemical Resistance: As follows when tested with indicated reagents according to NEMA LD 3, Test Procedure 3.4.5:

   a. No Effect: Acetic acid (98 percent), acetone, ammonium hydroxide (28 percent), benzene, carbon tetrachloride, dimethyl formamide, ethyl acetate, ethyl alcohol, ethyl ether, methyl alcohol, nitric acid (70 percent), phenol, sulfuric acid (60 percent), and toluene.
   b. Slight Effect: Chromic acid (60 percent) and sodium hydroxide (50 percent).


E. Polypropylene: Unreinforced polypropylene complying with ASTM D 4101, Group 01, Class 1, Grade 2.
F. Glass: Clear, laminated tempered glass complying with ASTM C 1172, Kind LT, Condition A, Type I, Class I, Quality-Q3; with two plies not less than 3.0 mm thick and with clear, polyvinyl butyral interlayer.

2. Permanently mark safety glass with certification label of the SGCC. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

G. Electrical Components, Devices, and Accessories:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

H. Fasteners: Provide stainless-steel fasteners where exposed to fumes.

2.6 FABRICATION

A. General: Assemble fume hoods in factory to greatest extent possible. Disassemble fume hoods only as necessary for shipping and handling limitations. Fume hoods shall be capable of being partly disassembled as necessary to permit movement through a 889-by-2007-mm (35-by-79-inch) door opening.

B. Steel Exterior: Fabricate from steel sheet, 1.21 mm (0.048 inch) thick, with component parts screwed together to allow removal of end panels, front fascia, and airfoil and to allow access to plumbing lines and service fittings. Apply chemical-resistant finish to interior and exterior surfaces of component parts before assembly.

C. Product Option: Provide either steel or fiberglass exterior as specified above.

D. Ends: Fabricate with double-wall end panels without projecting corner posts or other obstructions to interfere with smooth, even airflow. Close area between double walls at front of fume hood and as needed to house sash counterbalance weights, utility lines, and remote-control valves.

E. Splay top and sides of face opening to provide an aerodynamic shape to ensure smooth, even flow of air into fume hood.

F. Interior Lining: Provide the following:

1. Glass-fiber-reinforced polyester, not less than 4.75 mm (3/16 inch) thick.

G. Lining Assembly: Unless otherwise indicated, assemble with stainless-steel fasteners or epoxy adhesive, concealed where possible. Seal joints by filling with chemical-resistant sealant during assembly.

1. Fasten lining components to a rigid frame assembly fabricated from stainless steel and to which exterior panels are attached.
2. Punch fume hood lining side panels to receive service fittings and remote controls. Provide removable plug buttons for holes not used for indicated fittings.
H. Rear Baffle: Unless otherwise indicated, provide baffle, of same material as fume hood lining, at rear of hood with openings at top and bottom. Secure baffle to cleats at rear of hood with stainless-steel screws. Fabricate baffle for easy removal for cleaning behind baffle.

1. Provide adjustable baffles with control adjustment strips at top and bottom with plastic or stainless-steel knobs.
2. Provide epoxy-coated, stainless-steel screen at bottom baffle opening to prevent paper from being drawn into the exhaust plenum behind baffles.

I. Exhaust Plenum: Full width of fume hood and with adequate volume to provide uniform airflow from hood, of same material as hood lining, and with duct stub for exhaust connection.


J. Bypass Grilles: Provide grilles at bypass openings of fume hoods.

K. Sashes: Provide operable sashes of type indicated.

1. Fabricate from 1.27-mm- (0.050-inch-) thick stainless steel or PVC extrusions. Form into four-sided frame with bottom corners welded and finished smooth. Make top member removable for glazing replacement. Set glazing in chemical-resistant, U-shaped gaskets.
2. Glaze with laminated safety glass.
3. Counterbalance vertical-sliding sash with sash weight and stainless-steel cable system to hold sash in place regardless of position. Provide ball-bearing sheaves, plastic glides in stainless-steel guides, and stainless-steel lift handles. Provide rubber bumpers at top and bottom of each sash unit.
4. Fabricate horizontal-sliding sashes hung from adjustable nylon-tired, ball-bearing sheaves supported on an overhead stainless-steel track. Provide a lower track for guiding sashes only. Sashes shall bypass and be removable. Provide flush finger pulls and rubber bumpers at both stiles of each sash.

L. Airfoil: Unless otherwise indicated, provide airfoil at bottom of fume hood face opening with 25-mm (1-inch) space between airfoil and work top. Sash closes on top of airfoil, leaving 25-mm (1-inch) opening for air intake. Airfoil directs airflow across work top to remove heavier-than-air gases and to prevent reverse airflow.

1. Fabricate airfoil from stainless steel.

M. Light Fixtures: Provide vapor proof, two-tube, rapid-start, fluorescent light fixtures, of longest practicable length; complete with tubes at each fume hood. Shield tubes from hood interior with 6.35-mm- (1/4-inch-) thick laminated glass or 3-mm-thick tempered glass, sealed into hood with chemical-resistant rubber gaskets. Provide units with fluorescent tubes easily replaceable from outside of fume hood.

1. Provide fluorescent tubes with color temperature of 3500 K and minimum color-rendering index of 85.
2.7 FUME HOOD BASE CABINETS WORK TOPS, CUP SINK AND SERVICE FITTINGS

A. POLYETHYLENE LINED ACID/CORROSIVE STORAGE CABINETS

1. Modular steel base unit specifically manufactured for use beneath fume hood superstructure for storage of corrosive materials.
2. Color: Match fume hood color.
3. Cabinet shall have a flush front panel.
4. Cabinet shall have removable back panel.
5. Cabinet back shall have vent hole designed to vent acid fumes to the fume hood above. Requires penetration in fume hood work surface.
6. Cabinet interior shall be chemical resistant 3/16” thick molded polyethylene lining with coved corners and 1” lip at front cabinet opening.
7. Cabinet doors shall be lined with 1/8” thick polyethylene.
8. Provide cabinet with one half-depth polyethylene shelf and polyethylene spill tray.
9. Provide filler panel from back of cabinet to the wall to close the service chase where service chase is exposed in the final installation.
10. Accessories:
   a. Cabinet shall be furnished with a PVC vent assembly.

B. Work Tops: Epoxy

1. Work-Top Configuration: Raised (marine) edge with beveled or rounded edge and corners.
2. Where acid storage cabinets are indicated beneath fume hoods, provide holes in work tops as need to accommodate cabinet vents.
3. Where epoxy sinks occur in epoxy work tops, provide integral sinks bonded to tops with invisible joint line.
4. Where epoxy sinks occur in phenolic-composite work tops, provide drop-in sinks with 6-mm (1/4-inch) thick lip around perimeter of sink.

C. Cup Sinks: Epoxy 75-by-228-mm (3-by-9-inch) oval.

1. Provide with stainless-steel strainers and integral tailpieces.

2.8 CHEMICAL-RESISTANT FINISH

A. General: Prepare, treat, and finish welded assemblies after welding. Prepare, treat, and finish components that are to be assembled with mechanical fasteners before assembling. Prepare, treat, and finish concealed surfaces same as exposed surfaces.

B. Preparation: Clean steel surfaces, other than stainless steel, of mill scale, rust, oil, and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it.

C. Chemical-Resistant Finish: Immediately after cleaning and pretreating, apply fume hood manufacturer's standard two-coat, chemical-resistant, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 0.05 mm 1.5 mils(0.038 mm).
1. Chemical and Physical Resistance of Finish System: Finish complies with acceptance levels of cabinet surface finish tests in SEFA 8M. Acceptance level for chemical spot test shall be no more than four Level 3 conditions.

2. Colors for Fume Hood Finish: As selected by Architect from manufacturer's full range.

2.9 ACCESSORIES

A. Sash Stops: Provide fume hoods with sash stops to limit hood opening to 50 percent of sash height. Sash stops can be manually released to open sash fully for cleaning fume hood and for placing large apparatus within fume hood.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of fume hoods.

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

3.2 INSTALLATION

A. General: Install fume hoods according to manufacturer's written instructions. Install level, plumb, and true; shim as required, using concealed shims, and securely anchor to building and adjacent laboratory casework. Securely attach access panels but provide for easy removal and secure reattachment. Where fume hoods abut other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.

B. Comply with requirements in Division 12 Laboratory Casework for installing fume hood base cabinets, work tops, and sinks.

C. Comply with requirements for installing water and laboratory gas service fittings and electrical devices.

   1. Install fittings according to Shop Drawings, installation requirements in SEFA 2.3, and manufacturer's written instructions. Set bases and flanges of sink and work top-mounted fittings in sealant recommended by manufacturer of sink or work-top material. Securely anchor fittings to fume hoods unless otherwise indicated.

3.3 FIELD QUALITY CONTROL

A. Field test installed fume hoods according to ASHRAE 110 as modified in "Performance Requirements" Article to verify compliance with performance requirements.

   1. Adjust fume hoods, hood exhaust fans, and building's HVAC system, or replace hoods and make other corrections until tested hoods perform as specified.
2. After making corrections, retest fume hoods that failed to perform as specified.

3.4 ADJUSTING AND CLEANING

A. Adjust moving parts for smooth, near silent, accurate sash operation with one hand. Adjust sashes for uniform contact of rubber bumpers. Verify that counterbalances operate without interference.

B. Clean finished surfaces, including both sides of glass; touch up as required; and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.

3.5 FUME HOOD SCHEDULE

A. Bench-Top Fume Hood Type:

1. Exterior: Steel with chemical-resistant finish.
2. Ventilation Type: Constant volume, Open By- Pass.
3. Sash Configuration:
   a. Operation: Vertical-sliding, single-hung sash opening Height: 685 to 762 mm (27 to 30 inches).
5. Cup Sinks: Epoxy 75-by-228-mm (3-by-9-inch) oval.
6. Service Fittings:
   a. General: Provide pre-wired and pre-piped fume hood assembly with point of service connections at top of hood.
   b. Water: One remote-control, rigid, gooseneck, single-service faucet(s) with vacuum breaker and removable serrated outlet.
      1) One potable water fitting.
   c. Laboratory Gas for Gas and Compressed Air, flange-type fitting(s) with angled outlet and remote-control needle valve.
   d. Electrical: Two duplex receptacles] at both end(s) of hood, mounted on exterior front face of end pilaster.
      1) Provide GFCI receptacles.

3.6 PREPARATION

A. TESTS:
   1. Conduct final tests of all equipment after all connections are made.
   2. ASHRAE/110-1995 test

Perform tests after installation is complete, the building ventilation system has been balanced, all connections have been made, and provide written verification that the above conditions have been met.

Acceptable Testing/Certification Agencies:
B. DEMONSTRATION:
   1. Manufacturer's authorized service personnel shall demonstrate proper operation to Owner's personnel.
   2. Manufacturer's authorized service personnel shall demonstrate servicing and maintenance requirements.

END OF SECTION 115313
SECTION 123553- WOOD LABORATORY CASEWORK

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. Wood laboratory casework.
2. Filler and closure panels.
3. Laboratory casework system that includes supports, filler and closure panels, and mobile drawer units.
4. Laboratory countertops & back splash
5. Equipment platform

B. Related Requirements:

1. Section 055000 “Metal Fabrications” for overhead platform.
2. Section 079200 “Sealant”

1.3 DEFINITIONS

A. Exposed Surfaces of Casework: Surfaces visible when doors and drawers are closed, including bottoms of cabinets more than 48 inches above floor, and visible surfaces in open cabinets or behind glass doors.

1. Ends of cabinets, including those installed directly against walls or other cabinets, are defined as "exposed."
2. Ends of cabinets indicated to be installed directly against and completely concealed by walls or other cabinets are defined as "concealed."

B. Semiexposed Surfaces of Casework: Surfaces behind opaque doors, such as cabinet interiors, shelves, and dividers; interiors and sides of drawers; and interior faces of doors. Tops of cases 78 inches or more above floor and bottoms of cabinets more than 24 inches but less than 48 inches above floor are defined as semiexposed.

C. Concealed Surfaces of Casework: Include sleepers, web frames, dust panels, and other surfaces not usually visible after installation.
D. MDF: Medium-density fiberboard.

E. Hardwood Plywood: A panel product composed of layers, or plies, of veneer, or of veneers in combination with lumber core, hardboard core, MDF core, or particleboard core, joined with adhesive and faced both front and back with hardwood veneers.

1.4 COORDINATION

A. Coordinate layout and installation of framing and reinforcements for support of laboratory casework.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For laboratory casework. Include plans, elevations, sections, and attachment details.

   1. Indicate types and sizes of cabinets.
   2. Indicate locations of hardware.
   3. Indicate locations of blocking and reinforcements required for installing laboratory casework.

D. Samples for Initial Selection: For cabinet finishes and other materials requiring color selection.

E. Samples for Verification: For each type of cabinet finish and each type of countertop material, in manufacturer's standard sizes.

F. Samples for Verification: Unless otherwise directed, approved full-size Samples may become part of the completed Work.

G. Delegated-Design Submittal: For laboratory casework indicated to comply with seismic performance requirements, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer.

B. Product Test Reports for Casework: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating compliance of laboratory casework with requirements of specified product standard.

C. Product Test Reports for Countertop Surface Material: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating compliance of laboratory countertop surface materials with requirements specified for chemical and physical resistance.
1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish complete touchup kit for each type and color of wood laboratory casework provided. Include scratch fillers, stains, finishes, and other materials necessary to perform permanent repairs to damaged laboratory casework finish.

B. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Cabinet Mounting Clips and Related Hardware: Quantity equal to 5 percent of amount installed, but no fewer than 20 of each type.
2. Modular Countertop Units: Two extra units of each length and material installed.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect finished surfaces during handling and installation with protective covering of polyethylene film or other suitable material.

B. Locate concealed framing, blocking, and reinforcements that support casework by field measurements before being enclosed, and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following:

1. Kewaunee Scientific Corporation; Laboratory Division.
2. Campbell Rhea.
3. Collegedale Casework, Inc.

B. Source Limitations: Obtain laboratory casework from single source from single manufacturer unless otherwise indicated.

1. Obtain countertops, bracket supports from casework manufacturer.

C. Product Designations: Drawings indicate sizes and configurations of laboratory casework by referencing designated manufacturer's catalog numbers. Other manufacturers' laboratory casework of similar sizes and similar door and drawer configurations and complying with Specifications may be considered.
2.2 PERFORMANCE REQUIREMENTS

A. System Structural Performance: Laboratory casework and support framing system shall withstand the effects of the following gravity loads and stresses without permanent deformation, excessive deflection, or binding of drawers and doors:

5. Shelves: 40 lb/sq. ft.

2.3 CASEWORK, GENERAL

A. Casework Product Standard: Comply with SEFA 8 W, "Laboratory Grade Wood Casework."

B. Low-Emitting Materials: Fabricate casework, including countertops, with adhesives and composite wood products containing no urea formaldehyde.

2.4 WOOD CASEWORK

A. Design: Flush overlay with square edges and 1/8” reveal between door or drawer and frame. Provide 1/16” reveal between doors or drawers and cabinet ends.

B. Wood Species and veneer cut: White Maple, plain sliced

C. Matching:

1. None required; select and arrange components for compatible grain and color.

D. Grain Direction:

1. Vertical on both doors and drawer fronts, with continuous vertical matching.
2. Vertical on end panels.
3. Vertical on knee-space panels.
4. Horizontal on aprons and table frames.

E. Exposed Materials:

1. General: Provide materials that are selected and arranged for compatible grain and color. Do not use materials adjacent to one another that are noticeably dissimilar in color, grain, figure, or natural character markings.
2. Plywood: Hardwood plywood, either veneer core or particleboard core with face veneer of species indicated. Grade A exposed faces, at least 1/50 inch thick, and Grade J crossbands. Provide backs of same species as faces.

F. Semiexposed Materials:
1. Solid Wood: Sound hardwood lumber, selected to eliminate appearance defects, of same species as exposed solid wood.
2. Plywood: Hardwood plywood of same species as exposed plywood. Grade B faces and Grade J Crossbands. Provide backs of same species as faces.

Concealed Materials:

3. Solid Wood: Any species, with no defects affecting strength or utility.
5. Particleboard.
6. MDF.

2.5 WOOD CABINET MATERIALS

A. General:

1. Maximum Moisture Content for Lumber: 7 percent for hardwood and 12 percent for softwood.

B. Hardwood Plywood: HPVA HP-1, particleboard core except where veneer core is indicated, and made without urea formaldehyde

C. MDF: ANSI A208.2, Grade 130; made with binder containing no urea formaldehyde

D. Particleboard: ANSI A208.1, Grade M-2; made with binder containing no urea formaldehyde.

E. Hardboard: ANSI A135.4, Class 1 Tempered.

F. Edge banding for Wood-Veneered Construction: Minimum 1/8-inch-thick, solid wood of same species as face veneer.

1. Select wood edge banding for grain and color compatible with face veneers.

2.6 MOBILE CABINETS/DRAWER UNITS

a. Furnish with finishes veneer top, end panels and back. End panels banded and finished, front back and top
b. Provide with two concealed fixed casters at rear and two locking casters at front
c. Drawers to have interlocking drawer system and counter balanced weights to prevent tipping

2.7 FABRICATION

A. Construction: Provide wood-faced laboratory casework complying with SEFA 8 W and of the following minimum construction:

1. Bottoms of Base Cabinets and Tall Cabinets: 3/4-inch-thick, hardwood plywood.
2. Tops and Bottoms of Wall Cabinets and Tops of Tall Cabinets: 1-inch-thick, veneer-core hardwood plywood.
3. Ends of Cabinets: 3/4-inch-thick, hardwood plywood.
5. Base Cabinet Top Frames: 3/4-by-2-inch solid wood with mortise and tenon or doweled connections, glued and pinned or screwed.
6. Base Cabinet Stretchers: 3/4-by-4-1/2-inch panel product strips or solid-wood boards at front and back of cabinet, glued and pinned or screwed. May be provided as an option to base cabinet top frames.
7. Base Cabinet Sub tops: 3/4-inch-thick panel product glued and pinned or screwed. May be provided as an option to base cabinet top frames.
9. Unexposed Backs of Cabinets: 1/4-inch-thick, hardwood plywood dadoed into sides, bottoms, and tops, unless otherwise indicated.
10. Drawer Fronts: 3/4-inch-thick, hardwood plywood or solid hardwood.
11. Drawer Sides and Backs: 1/2-inch-thick, solid hardwood or hardwood plywood, with glued dovetail or multiple-dowel joints.
12. Drawer Bottoms: 1/4-inch-thick, veneer-core hardwood plywood glued and dadoed into front, back, and sides of drawers.
13. Doors: 3/4 inch thick, with particleboard or MDF cores and hardwood face veneers and crossbands.
14. Doors More Than 48 Inches High: 1-1/16 inches thick, with honeycomb cores, solid-hardwood stiles and rails, and hardwood face veneers and crossbands.
15. Doors More Than 48 Inches High: 1-1/8 inches thick, with particleboard cores and hardwood face veneers and crossbands.

B. Filler and Closure Panels: Provide where indicated and as needed to close spaces between cabinets and walls, ceilings, and indicated equipment. Fabricate from same material and with same finish as adjacent exposed cabinet surfaces unless otherwise indicated.

2.8 LABORATORY CASEWORK SYSTEM

A. Provide casework manufacturer's standard integrated system that includes support framing, suspended modular wood cabinets, filler and closure panels, countertops, and fittings needed to assemble system. System includes hardware and fasteners for securing support framing to permanent construction.

1. Cabinets can be removed and reinstalled without use of special tools for relocation within system.
2. Base cabinets can be removed without providing temporary support for, or removing, countertops.
3. System includes filler and closure panels to close spaces between support framing, cabinets, shelves, countertops, floors, and walls unless otherwise indicated. Fabricate from same material and with same finish as adjacent exposed cabinet surfaces unless otherwise indicated.
B. Support Framing: Casework manufacturer's standard system consisting of vertical supports and connecting braces and rails as follows:

1. Cabinets, shelves, and countertops are supported from vertical supports. Vertical positioning of supported cabinets, shelves, and countertops can be varied in 1-inch increments through full height of supports.
2. Vertical supports rest on adjustable leveling bases and are secured to floor with metal clips fastened to floor.
3. Vertical supports are installed with braces and rails, connecting them to each other and to permanent building walls to create a stable, rigid structure with framed utility spaces where indicated.
4. Vertical supports are braced at floor with cantilevered horizontal leg members where indicated.

C. Countertops: Provide in modular lengths indicated, without seams.

2.9 WOOD FINISH

A. Preparation: Sand lumber and plywood before assembling. Sand edges of doors, drawer fronts, and molded shapes with profile-edge sander. Sand after assembling for uniform smoothness at least equivalent to that produced by 220-grit sanding and without machine marks, cross sanding, or other surface blemishes.

B. Staining: Remove fibers and dust and apply stain to exposed and semiexposed surfaces as necessary to match approved Samples. Apply stain in a manner that produces a consistent appearance. Apply wash-coat sealer before applying stain to closed-grain wood species.


C. Chemical-Resistant Finish: Apply laboratory casework manufacturer's standard two-coat, chemical-resistant, transparent finish. Sand and wipe clean between coats. Topcoat(s) may be omitted on concealed surfaces.

1. Chemical and Physical Resistance of Finish System: Finish complies with acceptance levels of cabinet surface finish tests in SEFA 8 W. Acceptance level for chemical spot test shall be no more than four Level 3 conditions.

2.10 HARDWARE

A. General: Provide laboratory casework manufacturer's standard, commercial-quality, heavy-duty hardware complying with requirements indicated for each type.

B. Hinges: Hinges shall be the five (5) knuckle, satin finish stainless steel, institutional, offset type for all swinging doors. Hinges shall be 2-3/4" long, and secured to cabinet and doors with flathead screws, so applied to withstand a weight load of 150 lbs. minimum.

C. Hinged Door and Drawer Pulls: Solid-aluminum, stainless-steel, or chrome-plated-brass back-mounted pulls. Provide two pulls for drawers more than 24 inches wide.
1. Design: Wire pulls.
2. Overall Size: 1 by 4-1/2 inches.

D. Door Catches: Dual, self-aligning, permanent magnet catches. Provide two catches on doors more than 48 inches high.

E. Drawer Slides: Drawer slides shall be zinc plated, cold rolled steel, full extension, linear ball bearing slides rated at 100 pounds minimum. The drawer shall be removable without the use of tools.

F. Adjustable Shelf Supports: Powder-coated steel shelf rests complying with BHMA A156.9, Type B04013.

2.11 COUNTERTOPS

A. Basis of design: Trespa TopLab\textsuperscript{BASE} (Double Sided Crystal).
   Thickness: \textfrac{3}{4}”
   Color: black

1. Acceptable Manufacturers:
   a. Trespa North America
   b. Other Manufacturers as approved by the Architect prior to bidding.

B. FABRICATION

1. Drip grooves shall be provided on the underside at all exposed edges unless otherwise noted on Laboratory Furnishings Drawings.

2. All exposed edges to be sanded to a smooth finish and, except as indicated below, shall be rounded to a \textfrac{1}{4}” radius at front top edge and at vertical corners.

3. Fix work surface panels with blind fastenings into the back or underside of the panel. Use #10, type A sheet metal screws sized to stop at least 1/8” short of the finished face. Pre-drill panel with an 11/64” diameter high speed drills bit aligned with 7/32” clearance holes in the supporting structure.

4. Form tight-fitting butt joints in the work surface using two part epoxy adhesive, or mechanical fasteners positioned to be concealed after installation.

C. SOURCE QUALITY CONTROL

1. Panels shall be of material specifically designed for laboratory work surfaces. Fabricated work surfaces shall comply with all current codes and regulations. Tops and shelves shall have uniform thickness (+0.03”) and flatness (maximum difference of 0.03”) for 10 foot span.

2. Panels to be U.L. registered and labeled for quality consistency.
3. Chemical Resistance: Evaluation of chemical resistance is based on SEFA 3-2010 Laboratory Work Surfaces (Scientific Equipment and Furniture Association) standard list of 49 chemicals / concentrations, their required methods of testing (24 hour surface test) and their minimum acceptable results as a means of establishing a minimum acceptable level of performance for all exposed and semi-exposed surfaces. All solid composite phenolic panels will meet 2010 SEFA 3 testing requirements for chemical resistance (24 hour standard.)

4. Panels to have screw pull-out strength minimums per following chart (lbs.):

<table>
<thead>
<tr>
<th>Screw depth:</th>
<th>#6</th>
<th>#8</th>
<th>#10</th>
<th>#12</th>
<th>1/4”</th>
<th>5/16”</th>
<th>3/8”</th>
<th>7/16”</th>
<th>1/2”</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2” panels:</td>
<td>250</td>
<td>300</td>
<td>340</td>
<td>390</td>
<td>450</td>
<td>560</td>
<td>680</td>
<td>790</td>
<td>900</td>
</tr>
<tr>
<td>5/8” panels:</td>
<td>310</td>
<td>370</td>
<td>430</td>
<td>490</td>
<td>560</td>
<td>710</td>
<td>850</td>
<td>990</td>
<td>1,100</td>
</tr>
<tr>
<td>3/4” panels:</td>
<td>510</td>
<td>590</td>
<td>680</td>
<td>850</td>
<td>1,000</td>
<td>1,200</td>
<td>1,400</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5. Uniform load to cause no more than 1/4” deflection at center of the span:

<table>
<thead>
<tr>
<th>Thickness</th>
<th>12” x 24”</th>
<th>12” x 36”</th>
<th>12” x 48”</th>
<th>24” x 36”</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2” panels:</td>
<td>370</td>
<td>110</td>
<td>45</td>
<td>220</td>
</tr>
<tr>
<td>5/8” panels:</td>
<td>690</td>
<td>210</td>
<td>85</td>
<td>410</td>
</tr>
<tr>
<td>3/4” panels:</td>
<td>1,400</td>
<td>400</td>
<td>170</td>
<td>800</td>
</tr>
<tr>
<td>1” panels:</td>
<td>2,600</td>
<td>780</td>
<td>330</td>
<td>1,500</td>
</tr>
</tbody>
</table>

6. Performance requirements:
1. Modulus of elasticity: 1,500,000 psi minimum.
3. Compressive strength: 24,000 psi minimum.
4. Weight: 93 lbs. per cubic foot maximum.
5. Flame spread (ASTM E-84): Class 1A (25).
7. Will not support micro-organic growth.

2.12 SHELVING & OVERHEAD PLATFORM

A. Wall shelving, Platform:
1. Wall shelving shall be ¾” laminate faced both sides with plastic laminate, with 3mm edging on exposed ends.
2. Standards shall be #KV85 double-slotted type 48” long unless otherwise noted on drawings. In no case shall spacing exceed 36” on center.
3. Brackets shall be KV185 with KV106 Shelf Rest.. Shelves shall be screwed to each shelf rest with two screws per shelf rest.

B. Heavy Duty Shelves & Platform Supports:
   a) Shelf supports shall be Unistrut Channels #P-1000 with Unistrut shelf brackets as detailed.
   b) Or Painted Metal Angles

2.13 UNISTRUT

A. Provide all Unistrut indicated on laboratory casework elevations and details.
   1. Provide horizontal Unistrut anchored to wall at piping drops.
      a) 4’-0” maximum spacing or as indicated on drawings
   2. Exposed to view members and components to have factory-applied epoxy-powdered coating. Color selected by architect.
3. Concealed members and components to have manufacturer’s standard enamel coating.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances, location of reinforcements, and other conditions affecting performance of the Work.

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

3.2 INSTALLATION OF CABINETS

A. Comply with installation requirements in SEFA 2.3. Install level, plumb, and true; shim as required, using concealed shims. Where laboratory casework abuts other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical. Do not exceed the following tolerances:

1. Variation of Tops of Base Cabinets from Level: 1/16 inch in 10 feet.
2. Variation of Bottoms of Upper Cabinets from Level: 1/8 inch in 10 feet.
3. Variation of Faces of Cabinets from a True Plane: 1/8 inch in 10 feet.
5. Variation in Alignment of Adjacent Door and Drawer Edges: 1/16 inch.

B. Utility-Space Framing: Secure to floor with two fasteners at each frame. Fasten to partition framing, wood blocking, or metal reinforcements in partitions and to base cabinets.

C. Base Cabinets: Fasten cabinets to utility-space framing, partition framing, wood blocking, or reinforcements in partitions, with fasteners spaced not more than 16 inches o.c. Bolt adjacent cabinets together with joints flush, tight, and uniform.

1. Where base cabinets are installed away from walls, fasten to floor at toe space at not more than 24 inches o.c. and at sides of cabinets with not less than two fasteners per side.

D. Wall Cabinets: Fasten to hanging strips, masonry, partition framing, blocking, or reinforcements in partitions. Fasten each cabinet through back, near top, at not less than 16 inches o.c.

E. Install hardware uniformly and precisely. Set hinges snug and flat in mortises.

F. Adjust laboratory casework and hardware so doors and drawers align and operate smoothly without warp or bind and contact points meet accurately. Lubricate operating hardware as recommended by manufacturer.

3.3 INSTALLATION OF COUNTERTOPS

A. Comply with installation requirements in SEFA 2.3. Abut top and edge surfaces in one true plane with flush hairline joints and with internal supports placed to prevent deflection. Locate
joints only where indicated on Shop Drawings.

B. Field Jointing: Where possible, make in same manner as shop-made joints using dowels, splines, fasteners, adhesives, and sealants recommended by manufacturer. Shop prepare edges for field-made joints.

1. Use concealed clamping devices for field-made joints in plastic-laminate countertops. Locate clamping devices within 6 inches of front and back edges and at intervals not exceeding 24 inches. Tighten according to manufacturer's written instructions to exert a uniform heavy pressure at joints.

C. Fastening:

1. Secure countertops, except for epoxy countertops, to cabinets with Z-type fasteners or equivalent, using two or more fasteners at each cabinet front, end, and back.
2. Secure epoxy countertops to cabinets with epoxy cement, applied at each corner and along perimeter edges at not more than 48 inches o.c.
3. Where necessary to penetrate countertops with fasteners, countersink heads approximately 1/8 inch and plug hole flush with material equal to countertop in chemical resistance, hardness, and appearance.

D. Provide scribe moldings for closures at junctures of countertop, curb, and splash with walls as recommended by manufacturer for materials involved. Match materials and finish to adjacent laboratory casework. Use chemical-resistant, permanently elastic sealing compound where recommended by manufacturer.

E. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

3.4 INSTALLATION OF LABORATORY ACCESSORIES

A. Install accessories according to Shop Drawings, installation requirements in SEFA 2.3, and manufacturer's written instructions.

B. Securely fasten adjustable shelving supports, metal shelves

C. Install shelf standards plumb and at heights to align shelf brackets for level shelves. Install shelving level and straight, closely fitted to other work where indicated.

3.5 CLEANING AND PROTECTING

A. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.

B. Protect countertop surfaces during construction with 6-mil plastic or other suitable water-resistant covering. Tape to underside of countertop at a minimum of 48 inches o.c.

END OF SECTION 123553
SECTION 22 05 00 – COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Section 230100 “Basic Mechanical Requirements,” and Section 230500 “Basic Mechanical Materials and Methods” apply to the work of this Section as if fully repeated herein.

1.2 SUMMARY

A. Section Includes:
   1. Transition fittings.
   2. Dielectric fittings.
   3. Mechanical sleeve seals.
   4. Sleeves.
   5. Escutcheons.
   7. Plumbing demolition.
   8. Painting and finishing.

1.3 DEFINITIONS

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

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

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

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

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

A. Product Data: For the following:
   1. Mechanical sleeve seals.

B. Welding certificates.

1.5 QUALITY ASSURANCE

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

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

C. Electrical Characteristics for 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.

1.6 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.

1.7 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 poured-in-place concrete and other structural components as they are constructed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for 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, the manufacturers specified.
2.2 PIPE, TUBE, AND FITTINGS

A. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 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 thickness or specific material is 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.
   2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

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

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

2.4 TRANSITION FITTINGS

A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

   1. Available Manufacturers:
      b. Dresser Industries, Inc.; DMD Div.
      c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
      d. JCM Industries.
      e. Smith-Blair, Inc.
      f. Viking Johnson.

   2. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
   4. Aboveground Pressure Piping: Pipe fitting.

B. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.
2.5 DIELECTRIC FITTINGS

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

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

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.

1. Available Manufacturers:
   a. Capitol Manufacturing Co.
   b. Central Plastics Company.
   c. Eclipse, Inc.
   d. Epco Sales, Inc.
   g. Zurn Industries, Inc.; Wilkins Div.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

1. Available Manufacturers:
   a. Capitol Manufacturing Co.
   b. Central Plastics Company.
   c. Epco Sales, Inc.

E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

1. Available Manufacturers:
   a. Advance Products & Systems, Inc.
   b. Calpico, Inc.
   c. Central Plastics Company.
   d. Pipeline Seal and Insulator, Inc.

2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.

F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
1. Available Manufacturers:
   a. Calpico, Inc.
   b. Lochinvar Corp.

G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

1. Available Manufacturers:
   a. Perfection Corp.
   b. Precision Plumbing Products, Inc.
   c. Sioux Chief Manufacturing Co., Inc.
   d. Victaulic Co. of America.

2.6 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Available Manufacturers:
   a. Advance Products & Systems, Inc.
   b. Calpico, Inc.
   c. Metraflex Co.
   d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Include two for each sealing element.
4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

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

E. 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. Steel Pipe Sleeves: For pipes smaller than NPS 6.
   b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.

F. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

   1. Install steel pipe for sleeves smaller than 6 inches in diameter.
   2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
   3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

G. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

   1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

H. 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.

2.8 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.

   1. Finish: Polished chrome-plated.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.

   1. Finish: Polished chrome-plated.
E. One-Piece, Stamped-Steel Type: With set screw and chrome-plated finish.

F. Split-Plate, Stamped-Steel Type: With exposed-rivet hinge, set screw, and chrome-plated finish.

G. One-Piece, Floor-Plate Type: Cast-iron floor plate.

H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

I. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

1. New Piping:
   a. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
   b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
   c. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type and set screw.
   d. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with set screw.
   e. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw.

2.9 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 22 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 on Coordination Drawings.

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

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

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

J. Install piping to allow application of insulation.

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

L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

   1. New Piping:
      a. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
      b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
      c. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type and set screw.
      d. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with set screw.
      e. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw.

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

N. Permanent sleeves are not required for holes formed by removable PE sleeves.

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. 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. Verify final equipment locations for roughing-in.

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

3.2 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.

E. 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.

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.

3.3 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.

4. **Wet Piping Systems:** Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

### 3.4 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.

### 3.5 PAINTING

A. Painting of plumbing systems, equipment, and components is specified in Division 09 Sections "Paints and Coatings."

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

### 3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

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

C. Field Welding: Comply with AWS D1.1.
3.7 GROUTING

A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION
SECTION 22 05 23 – GENERAL DUTY VALVES FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Section 230100 “Basic Mechanical Requirements,” and Section 230500 “Basic Mechanical Materials and Methods” apply to the work of this Section as if fully repeated herein.

1.2 SUMMARY

A. Section Includes:

1. Bronze ball valves.
2. Iron, single-flange butterfly valves.

B. Related Sections:

1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
2. Division 23, Section 230500 “Basic Mechanical Materials and Methods” for valve tags and schedules which applies to this section.

1.3 DEFINITIONS

A. CWP: Cold working pressure.
B. EPDM: Ethylene propylene copolymer rubber.
C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
D. NRS: Non-rising stem.
E. OS&Y: Outside screw and yoke.
F. RS: Rising stem.
G. SWP: Steam working pressure.

1.4 SUBMITTALS

A. Product Data: For each type of valve indicated.

1.5 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.

### 1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
4. Set butterfly valves closed or slightly open.
5. Block check valves in either closed or open position.

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.

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**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. **Valve Sizes:** Same as upstream piping unless otherwise indicated.

D. **Valve Actuator Types:**

1. Handwheel: For valves other than quarter-turn types.
2. Handlever: For quarter-turn valves NPS 6 and smaller.

E. **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.

F. **Valve-End Connections:**

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Grooved: With grooves according to AWWA C606.
4. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. Crane Co.; Crane Valve Group; Crane Valves.
   c. Walworth.

2. 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 or TFE.
   h. Stem: Stainless steel.
   i. Ball: Stainless steel, vented.
   j. Port: Full.

B. Three-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. Hammond Valve.
   c. Milwaukee Valve Company.
   d. NIBCO INC.

2. Description:
   b. SWP Rating: 150 psig.
   c. CWP Rating: 600 psig.
   d. Body Design: Three piece.
   e. Body Material: Bronze.
   f. Ends: Threaded.
   g. Seats: PTFE or TFE.
   h. Stem: Stainless steel.
   i. Ball: Stainless steel, vented.
   j. Port: Full.
2.3 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      b. Crane Co.; Crane Valve Group; Jenkins Valves.
      c. Crane Co.; Crane Valve Group; Stockham Division.
      d. Victaulic Series 300 and 704; grooved end only.

2. Description:

   a. Standard: MSS SP-67, Type I.
   b. CWP Rating: 200 psig.
   c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
   d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
   e. Seat: EPDM.
   f. Stem: One- or two-piece stainless steel.
   g. Disc: Nickel-plated ductile iron.

2.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

   1. Shutoff Service: Ball, butterfly, or plug valves.
   3. Throttling Service: Ball valves.
   4. Pump-Discharge Check Valves:

      a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
      b. NPS 2-1/2 and Larger for Domestic Water: Iron swing check valves with lever and weight resilient-seat check valves.
      c. NPS 2-1/2 and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight.

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

C. Select valves, except wafer types, with the following end connections:

   1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
   2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
   3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
   4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
   5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
   6. For Steel Piping, NPS 5 and Larger: Flanged ends.
   7. For Grooved-End Copper Tubing: Valve ends may be grooved.
2.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 1 and Smaller:
   1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
   2. Ball Valves: Three piece, full port, bronze with stainless-steel trim.
   3. Bronze Swing Check Valves: Class 125, bronze disc.

B. Pipe NPS 1-1/4 and 2:
   1. Bronze Valves: May be provided with solder-joint ends.
   2. Ball Valves: Two piece, full port, bronze with stainless-steel trim.
   3. Bronze Swing Check Valves: Class 125, bronze disc.

C. Pipe NPS 2-1/2 and Larger:
   1. Iron, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
   3. Iron Grooved-End Butterfly Valves: 175 CWP.

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

E. 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.

E. Install check valves for proper direction of flow and as follows:
1. Swing Check Valves: In horizontal position with hinge pin level.

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 or butterfly valves.
3. Throttling Service: Ball or butterfly valves.

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

C. Select valves, except wafer types, with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Copper Tubing, NPS 5 and Larger: Flanged ends.

3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 3 and smaller:

1. Bronze Valves: May be provided with solder-joint ends.
2. Ball Valves: Two piece, full port, bronze with stainless-steel trim.
3. Bronze Swing Check Valves: Class 125, bronze disc.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Section 230100 "Basic Mechanical Requirements," and Section 230500 "Basic Mechanical Materials and Methods" apply to the work of this Section as if fully repeated herein.

1.2 SUMMARY

A. Section Includes:
   1. Metal pipe hangers and supports.
   2. Trapeze pipe hangers.
   3. Thermal-hanger shield inserts.
   4. Fastener systems.
   5. Equipment supports.

B. Related Sections:
   1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
   2. Division 21 fire-suppression piping Sections for pipe hangers for fire-suppression piping.
   3. Division 23, Section 230500 “Basic Mechanical Materials and Methods”.

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 SUBMITTALS

A. Product Data: For each type of product indicated.
B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:

1. Trapeze pipe hangers.
2. Pipe stands.
3. Equipment supports.

C. Delegated-Design Submittal: For trapeze hangers 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. Detail fabrication and assembly of trapeze hangers.
2. Design Calculations: Calculate requirements for designing trapeze hangers.

D. Welding certificates.

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.
2.2 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 THERMAL-HANGER SHIELD INSERTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of 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: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-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.

2.4 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.

2.5 PIPE STANDS

A. General Requirements for Pipe Stands: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.

D. High-Type, Single-Pipe Stand:
   1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
   3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
   4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

E. High-Type, Multiple-Pipe Stand:
   1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
   2. Bases: One or more; plastic.
   3. Vertical Members: Two or more protective-coated-steel channels.
   4. Horizontal Member: Protective-coated-steel channel.
   5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.6 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.

2.7 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.8 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.

2.9 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

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 and attachments for general service applications.

F. Use copper-plated pipe hangers and copper 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 6.
2. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 6, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
3. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 6, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
4. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 6 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.

J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 and larger 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-joint 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. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

O. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

P. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

Q. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.
PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. 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.

B. 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.

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.

C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

D. 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.

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.

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. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

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 and attachments for general service applications.

F. Use copper-plated pipe hangers and copper 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 non-insulated or insulated, stationary pipes NPS 1/2 to NPS 6.
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 8.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 8 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-joint 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. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

O. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Section 230100 “Basic Mechanical Requirements,” and Section 230500 “Basic Mechanical Materials and Methods” apply to the work of this Section as if fully repeated herein.

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Pipe labels.
3. Valve tags.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

C. Valve numbering scheme.

D. Valve 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:

1. Material and Thickness: Brass, 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.

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lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

4. 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), plus 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), plus 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: 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-fourths the size of principal lettering.

G. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

H. 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.

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, 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: At least 1-1/2 inches high.

2.4 VALVE TAGS

A. Valve Tags: 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 wire-link chain.

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.

2.5 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: Approximately 4 inches by 7 inches.

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 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. Piping Color-Coding: Painting of piping is specified in Division 09 Section "Paints and Coatings."

B. 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 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.

C. Pipe Label Color Schedule:

1. Domestic Water Piping:
   a. Background Color: Blue.
2. Sanitary Waste and Storm Drainage Piping:
   a. Background Color: Black.
3. Identification for Plumbing Piping and Equipment:
   a. DCW Domestic Cold Water.
   b. DHW Domestic Hot Water.
   c. DHWR Domestic Hot Water Return.
   d. NPCW Non-potable Cold Water.
   e. NPHW Non-potable Hot Water.
   f. SW Sanitary Waste.
   g. SV Sanitary Vent.
   h. SPD Sump Pump Discharge.
   i. ST Storm Water.

3.4 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 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, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:
2. Valve-Tag Color:
b. Hot Water: Natural.

3. Letter Color:
   b. Hot Water: Black.

3.5 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION
SECTION 22 07 19 – PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Section 230100 “Basic Mechanical Requirements,” and Section 230500 “Basic Mechanical Materials and Methods” apply to the work of this Section as if fully repeated herein.

1.2 SUMMARY

A. Section includes insulating the following plumbing piping services:

1. Domestic cold-water piping.
2. Domestic hot-water piping.
3. Domestic recirculating hot-water piping.
4. Supplies and drains for handicap-accessible lavatories and sinks.

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 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. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in “Factory-Applied Jackets” Article.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Pittsburgh Corning Corporation; Foamglas.

2. Block Insulation: ASTM C 552, Type I.
3. Special-Shaped Insulation: ASTM C 552, Type III.
4. **Preformed Pipe Insulation without Jacket:** Comply with ASTM C 552, Type II, Class 1.

5. **Preformed Pipe Insulation with Factory-Applied ASJ-SSL:** Comply with ASTM C 552, Type II, Class 2.

6. **Factory fabricate shapes according to ASTM C 450 and ASTM C 585.**

G. **Flexible Elastomeric Insulation:** Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

1. **Products:** Subject to compliance with requirements, provide one of the following:
   - Aeroflex USA, Inc.; Aerocel.
   - Armacell LLC; AP Armaflex.
   - K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.

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. **Flexible Elastomeric and Polyolefin Adhesive:** Comply with MIL-A-24179A, Type II, Class I.

1. **Products:** Subject to compliance with requirements, provide one of the following:
   - Aeroflex USA, Inc.; Aeroseal.
   - Armacell LLC; Armaflex 520 Adhesive.
   - Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
   - K-Flex USA; R-373 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).

3. Use adhesive that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers," including 2004 Addenda.

C. **ASJ Adhesive:** Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. **Products:** Subject to compliance with requirements, provide one of the following:
   - Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
   - Eagle Bridges - Marathon Industries; 225.
   - Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

3. Use adhesive that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of
Volatile Organic Emissions from Various Sources Using Small-Scale
Environmental Chambers," including 2004 Addenda.

D. PVC Jacket Adhesive: Compatible with PVC jacket.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Dow Corning Corporation; 739, Dow Silicone.
      d. Speedline Corporation; Polyco VP Adhesive.

   2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   3. Use adhesive that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers," including 2004 Addenda.

2.3 MASTICS

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

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
   1. Products: Subject to compliance with requirements, provide one of the following:
      b. Vimasco Corporation; 749.

   2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
   3. Service Temperature Range: Minus 20 to plus 180 deg F.
   4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.

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

2.4 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass and Phenolic Products: Subject to compliance with requirements, provide one of the following:
   b. Eagle Bridges - Marathon Industries; 405.
   d. Mon-Eco Industries, Inc.; 44-05.
   e. Pittsburgh Corning Corporation; Pittseal 444.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: Minus 100 to plus 300 deg F.
5. Color: White or gray.
6. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Use sealants that comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers," including 2004 Addenda.

B. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
6. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Use sealants that comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers," including 2004 Addenda.

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-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

2.6 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, provide one of the following:
   a. ABI, Ideal Tape Division; 428 AWF ASJ.
   b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
   c. Compac Corporation; 104 and 105.
   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: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. ABI, Ideal Tape Division; 370 White PVC tape.
   b. Compac Corporation; 130.
   c. Venture Tape; 1506 CW NS.

2. Width: 2 inches.
3. Thickness: 6 mils.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

2.7 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide one of the following:
   a. ITW Insulation Systems; Gerrard Strapping and Seals.
   b. RPR Products, Inc.; Insul-Mate Strapping and Seals.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304; 0.015 inch thick, 1/2 inch wide with closed seal.
2.8 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Engineered Brass Company.
   b. Insul-Tect Products Co.; a subsidiary of MVG Molded Products.
   c. McGuire Manufacturing.
   d. Plumberex.
   e. Truebro; a brand of IPS Corporation.
   f. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.

2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

B. Protective Shielding Piping Enclosures:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   a. Truebro; a brand of IPS Corporation.
   b. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.

2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

2.9 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

2.10 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:

1. NPS 1-1/4 and Smaller: Insulation shall be one of the following:
   a. Flexible Elastomeric: 3/4 inch thick.

2. NPS 1-1/2 and Larger: Insulation shall be one of the following:
   a. Flexible Elastomeric: 1 inch thick.
B. Domestic Hot and Recirculated Hot Water:

1. NPS 1 and Smaller: Insulation shall be one of the following:
   a. Flexible Elastomeric: 1 inch thick.

2. NPS 1-1/4 to NPS 2: Insulation shall be one of the following:
   a. Flexible Elastomeric: 1 inch thick.

3. NPS 2-1/2 and Larger: Insulation shall be one of the following:

C. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F:

1. All Pipe Sizes: Insulation shall be one of the following:
   a. Flexible Elastomeric: 1 inch thick.

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION
SECTION 22 11 16 – DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Section 230100 “Basic Mechanical Requirements,” and Section 230500 “Basic Mechanical Materials and Methods” apply to the work of this Section as if fully repeated herein.

1.2 SUMMARY

A. Section Includes:
   1. Aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
   2. Specialty valves.
   3. Flexible connectors.

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.

1.4 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

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.

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.


2. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
2.3 PIPING JOINING MATERIALS

A. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

B. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys with minimum 15% silver bearing filler material for general-duty brazing unless otherwise indicated.

2.4 SPECIALTY VALVES

A. Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing" for general-duty metal valves.

B. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves, drain valves, backflow preventers, and vacuum breakers.

2.5 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.

C. Sleeve-Type Transition Coupling: AWWA C219.
   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. Cascade Waterworks Manufacturing.
      b. Dresser, Inc.; Dresser Piping Specialties.
      c. Ford Meter Box Company, Inc. (The).
      d. JCM Industries.
      e. Romac Industries, Inc.
      f. Smith-Blair, Inc; a Sensus company.
      g. Viking Johnson; c/o Mueller Co.

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. 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:
2. Description:


b. Pressure Rating: 150 psig.

c. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

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:

   b. Central Plastics Company.
   c. Matco-Norca, Inc.
   d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   e. Wilkins; a Zurn company.

2. Description:

   b. Factory-fabricated, bolted, companion-flange assembly.
   c. Pressure Rating: 150 psig.
   d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

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. Advance Products & Systems, Inc.
   b. Calpico, Inc.
   c. Central Plastics Company.
   d. Pipeline Seal and Insulator, Inc.

2. Description:

   a. Nonconducting materials for field assembly of companion flanges.
   b. Pressure Rating: 150 psig.
   c. Gasket: Neoprene or phenolic.
   d. Bolt Sleeves: Phenolic or polyethylene.
   e. Washers: Phenolic with steel backing washers.
E. Dielectric Nipples:

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. Elster Perfection.
   b. Grinnell Mechanical Products.
   c. Matco-Norca, Inc.
   d. Precision Plumbing Products, Inc.
   e. Victaulic Company.

2. Description:
   a. Standard: IAPMO PS 66
   b. Electroplated steel nipple. complying with ASTM F 1545.
   c. Pressure Rating: 300 psig at 225 deg F.
   d. End Connections: Male threaded or grooved.
   e. Lining: Inert and noncorrosive, propylene.

2.7 VALVE INSTALLATION

A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing" for valve installations.

B. 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. Use butterfly or gate valves for piping NPS 2-1/2 and larger.

C. Install drain valves for equipment at base of each water riser, 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 water mains, risers, and branches.

D. Install balancing valve in each hot-water circulation return branch and discharge side of each pump and circulator. Set balancing valves partly open to restrict but not stop flow. Use ball valves for piping NPS 2 and smaller and butterfly valves for piping NPS 2-1/2 and larger. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves.

E. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for calibrated balancing valves.
PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 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 copper tubing under building slab according to CDA's "Copper Tube Handbook."

C. Install shutoff valve immediately upstream of each dielectric fitting.

D. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.

E. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

F. 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.

G. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

H. Install piping adjacent to equipment and specialties to allow service and maintenance.

I. Install piping to permit valve servicing.

J. 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.

K. Install piping free of sags and bends.

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

M. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

N. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Common Work Results for Plumbing."

3.3 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. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

E. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

F. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.4 VALVE INSTALLATION

A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations.

B. 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. Use butterfly or gate valves for piping NPS 2-1/2 and larger.

C. Install drain valves for equipment at base of each water riser, 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 water mains, risers, and branches.

D. Install balancing valve in each hot-water circulation return branch and discharge side of each pump and circulator. Set balancing valves partly open to restrict but not stop flow. Use ball valves for piping NPS 2 and smaller and butterfly valves for piping NPS 2-1/2 and larger.

E. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for calibrated balancing valves.

3.5 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

3.6 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 nipples.
C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric nipples.

D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.7 FLEXIBLE CONNECTOR INSTALLATION

A. Install flexible connectors in suction and discharge piping connections to each domestic water pump.

B. Install bronze-hose flexible connectors in copper domestic water tubing.

3.8 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements in Division 22 Section "Hangers and Supports" for pipe hanger and support products and installation.

1. Vertical Piping: MSS Type 8 or 42, clamps.
2. Individual, Straight, Horizontal Piping Runs:
   a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
3. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support vertical piping and tubing at base and at each floor.

C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.

D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
   2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
   3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
   4. NPS 2-1/2: 108 inches with 1/2-inch rod.
   5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.

E. Install supports for vertical copper tubing every 10 feet.

3.9 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment and machines to allow service and maintenance.

3.10 IDENTIFICATION

A. Identify system components. Comply with requirements in Division 23 Section "Basic Mechanical Materials and Methods" which applies to the work of this section for identification materials and installation requirements associated with piping system identification.

3.11 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 Owner’s Representative.
   2. During installation, notify Owner’s Representative at least one day before inspection must be made. Perform tests specified below in presence of Owner’s Representative:
      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 to observe tests specified below and to ensure compliance with requirements.
   3. Reinspection: If Owner’s Representative finds that piping will not pass tests or inspections, make required corrections and arrange for reinspection.

C. Piping Tests:
   1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
   2. 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.
   3. 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.
   4. 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.
   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 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.

3.12 ADJUSTING

A. Perform the following adjustments before operation:
   1. Close drain valves, hydrants, and hose bibbs.
   2. Open shutoff valves to fully open position.
   3. Open throttling valves to proper setting.
   4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
      a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
      b. Adjust calibrated balancing valves to flows indicated.
5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
7. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.13 CLEANING

A. Clean and disinfect potable and non-potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting 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. Submit water samples in sterile bottles to Owner’s Representative. Repeat procedures if biological examination shows contamination.

B. Clean non-potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use the following procedures described below:
   a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
   b. Submit water samples in sterile bottles to Owner’s Representative. Repeat procedures if biological examination shows contamination.

C. Prepare and submit reports of purging and disinfecting activities.

D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.14 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. Aboveground domestic water piping, NPS 4 and smaller, shall be one of the following:
   
   1. Hard copper tube, ASTM B 88, Type L; cast- or wrought-lead free copper solder-
      joint fittings; and soldered joints.

3.15 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated,
   the following requirements apply:

   1. Shutoff Duty: Use ball valves for piping NPS 2 and smaller. Use butterfly valves
      with lug type for piping NPS 2-1/2 and larger.

B. Use check valves to maintain correct direction of domestic water flow to and from
   equipment.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Section 230100 “Basic Mechanical Requirements,” and Section 230500 “Basic Mechanical Materials and Methods” apply to the work of this Section as if fully repeated herein.

1.2 SUMMARY

A. This Section includes the following domestic water piping specialties:

1. Vacuum breakers.
2. Backflow preventers.
3. Hose bibbs.
4. Wall hydrants.
5. Drain valves.

B. Related Sections include the following:

1. Division 22 Section "Domestic Water Piping."
2. Division 23 Section 230500 “Basic Mechanical Materials and Methods.”

1.3 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

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. NSF Compliance:
2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 - PRODUCTS

2.1 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Ames Co.
   b. Cash Acme.
   c. Conbraco Industries, Inc.
   d. FEBCO; SPX Valves & Controls.
   e. Rain Bird Corporation.
   f. Toro Company (The); Irrigation Div.
   g. Watts Industries, Inc.; Water Products Div.
   h. Zurn Plumbing Products Group; Wilkins Div.

3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
5. Inlet and Outlet Connections: Threaded.
6. Finish: Chrome plated.

B. Hose-Connection Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Arrowhead Brass Products, Inc.
   b. Cash Acme.
   c. Conbraco Industries, Inc.
   d. Legend Valve.
   e. MIFAB, Inc.
   f. Prier Products, Inc.
   g. Watts Industries, Inc.; Water Products Div.
   h. Woodford Manufacturing Company.
   i. Zurn Plumbing Products Group; Light Commercial Operation.
   j. Zurn Plumbing Products Group; Wilkins Div.

5. Finish: Chrome.

2.2 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. FEBCO; SPX Valves & Controls.
   b. Zurn Plumbing Products Group; Wilkins Div.

3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
6. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
7. Configuration: Designed for horizontal, straight through flow.
8. Accessories:
   a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.

2.3 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. Flo Fab Inc.
   c. ITT Industries; Bell & Gossett Div.
   d. NIBCO INC.
   e. TAC Americas.
   f. Taco, Inc.
   g. Watts Industries, Inc.; Water Products Div.

2. Type: Ball or Y-pattern globe valve with two readout ports and memory setting indicator.
3. Body: Bronze,
4. Size: Same as connected piping, but not larger than NPS 2.
5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

2.4 STRAINERS FOR DOMESTIC WATER PIPING

A. Y- Pattern Strainers:

1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations, unless otherwise indicated.
5. Perforation Size:
2.5 HOSE BIBBS

A. Hose Bibbs:

4. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
10. Finish for Finished Rooms: Chrome plated.
12. Operation for Service Areas: Operating key.
14. Include operating key with each operating-key hose bibb.
15. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.6 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

2. Pressure Rating: 400-psig minimum CWP.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
8. Inlet: Threaded or solder joint.

2.7 WATER HAMMER ARRESTERS

A. Water Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Type: Metal bellows.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.
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 backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination.
   1. Locate backflow preventers in same room as connected equipment or system.
   2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
   3. Do not install bypass piping around backflow preventers.

C. Install balancing valves in locations where they can easily be adjusted.

D. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
   1. Install thermometers and water regulators if specified.
   2. Install cabinet-type units recessed in or surface mounted on wall as specified.

E. Install outlet boxes recessed in wall. Install 2-by-4-inch fire-retardant-treated-wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in Division 06 Section "Rough Carpentry."

F. Install water hammer arresters in water piping according to PDI-WH 201.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and prepare test reports:
   1. Test each reduced-pressure-principle backflow preventer according to authorities having jurisdiction and the device's reference standard.

B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.
3.4 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow set points of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION
SECTION 22 13 16 – SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Section 230100 “Basic Mechanical Requirements,” and Section 230500 “Basic Mechanical Materials and Methods” apply to the work of this Section as if fully repeated herein.

1.2 SUMMARY

A. This Section includes the following sanitary drainage piping specialties:

1. Cleanouts.
2. Floor drains.
3. Floor sinks.
4. Roof flashing assemblies.
5. Miscellaneous sanitary drainage piping specialties.
6. Flashing materials.

1.3 SUBMITTALS

A. Product Data for floor drains.

B. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation and maintenance manuals.

1.4 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.

1.5 COORDINATION

A. Coordinate size and location of roof penetrations.

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.
2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Extra Heavy class.
B. Gaskets: ASTM C 564, rubber.

2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.
B. Heavy-Duty, Hubless-Piping Couplings:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ANACO-Husky model #4000.
      b. Clamp-All Corp.
      c. Mission Rubber Company; a division of MCP Industries, Inc.
      d. Tyler Pipe.
   3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.4 COPPER TUBE AND FITTINGS

A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.
B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
C. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

2.5 SPECIALTY PIPE FITTINGS

A. Transition Couplings:
   1. General Requirements: Fitting or device for joining piping with small differences in OD’s or of different materials. Include end connections same size as and compatible with pipes to be joined.
   2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
   3. Unshielded, Nonpressure Transition Couplings:
      a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         2) Fernco Inc.
         3) Mission Rubber Company; a division of MCP Industries, Inc.
         4) Plastic Oddities; a division of Diverse Corporate Technologies, Inc.
c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
d.

Sleeve Materials:


4. Shielded, Nonpressure Transition Couplings:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

2) Mission Rubber Company; a division of MCP Industries, Inc.

c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

5. Pressure Transition Couplings:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

2) Dresser, Inc.
3) EBAA Iron, Inc.
4) JCM Industries, Inc.
5) Romac Industries, Inc.
6) Smith-Blair, Inc.; a Sensus company.
7) The Ford Meter Box Company, Inc.
8) Viking Johnson.

c. Description: Metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
d. Center-Sleeve Material: Manufacturer's standard.
e. Gasket Material: Natural or synthetic rubber.
f. Metal Component Finish: Corrosion-resistant coating or material.

B. Dielectric Fittings:

1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
2. Dielectric Nipples:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Elster Perfection.
2) Grinnell Mechanical Products.
3) Matco-Norca, Inc.
4) Precision Plumbing Products, Inc.
5) Victaulic Company.

b. Description:

1) Standard: IAPMO PS 66
2) Electroplated steel nipple.
3) Pressure Rating: 300 psig at 225 deg F.
4) End Connections: Male threaded or grooved.
5) Lining: Inert and noncorrosive, propylene.

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 cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate at base of each vertical soil and waste stack.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. 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. Set with grates depressed according to the following drainage area radii:

   a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.

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.

F. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
G. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.

H. Install deep-seal traps on floor drains and other waste outlets, if indicated.

I. 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.

J. Install wood-blocking reinforcement for wall-mounting-type specialties.

K. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 CONNECTIONS

   A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

   B. Install piping adjacent to equipment to allow service and maintenance.

3.3 FLASHING INSTALLATION

   A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:

      1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft, 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
      2. Copper Sheets: Solder joints of copper sheets.

   B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

      1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
      2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
      3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

   C. Set flashing on floors and roofs in solid coating of bituminous cement.

   D. Secure flashing into sleeve and specialty clamping ring or device.

   E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07 Section "Sheet Metal Flashing and Trim."

   F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

   G. Fabricate and install flashing and pans, sumps, and other drainage shapes.
3.4 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.

3.5 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.

3.6 PIPING SCHEDULE

A. Aboveground, soil and waste piping NPS 1-1/2 and smaller shall be the following:
   1. Copper DWV tube, copper drainage fittings, and soldered joints.

B. Aboveground, soil and waste piping NPS 2 and larger shall be the following:
   1. Hubless, cast-iron soil pipe and fittings heavy-duty hubless-piping couplings; and coupled joints.

C. Aboveground, vent piping NPS 2 and larger shall be the following:
   1. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.

D. Underground, soil, waste, and vent piping NPS 2 and larger shall be the following:
   1. Extra Heavy class, cast-iron soil piping; gaskets; and gasketed joints.

END OF SECTION
SECTION 22 13 19 – SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Section 230100 “Basic Mechanical Requirements,” and Section 230500 “Basic Mechanical Materials and Methods” apply to the work of this Section as if fully repeated herein.

1.2 SUMMARY

A. This Section includes the following sanitary drainage piping specialties:
   1. Cleanouts.
   2. Floor drains.
   3. Floor sinks.
   4. Roof flashing assemblies.
   5. Miscellaneous sanitary drainage piping specialties.
   6. Flashing materials.

1.3 SUBMITTALS

A. Product Data for floor drains.

B. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation and maintenance manuals.

1.4 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.

1.5 COORDINATION

A. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Exposed Metal Cleanouts:

   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:
c. Watts Drainage Products Inc.
d. Zum Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch or Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Metal Floor Cleanouts:

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:
   c. Watts Drainage Products Inc.
   d. Zum Plumbing Products Group; Specification Drainage Operation.
   e. Josam Company; Josam Div.

2. Standard: ASME A112.36.2M for cast-iron soil pipe with cast-iron ferrulem, heavy-duty, adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Cast-iron soil pipe with cast-iron ferrule, Heavy-duty, adjustable housing.
5. Body or Ferrule: Cast iron.
6. Clamping Device: Not required where slab on grade, otherwise required.
8. Closure: Brass plug with tapered threads.
11. Frame and Cover Shape: Round.
12. Top Loading Classification: Heavy Duty.
13. Riser: ASTM A 74, Extra-Heavy class, cast-iron drainage pipe fitting and riser to cleanout.
15. Size: Same as connected branch.

C. Cast-Iron Wall Cleanouts:

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:
   b. MIFAB, Inc.
   d. Tyler Pipe; Wade Div.
   e. Watts Drainage Products Inc.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

2.2 FLOOR DRAINS – SEE SCHEDULE ON DRAWINGS

2.3 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:
   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:
      a. Acorn Engineering Company; Elmdor/Stoneman Div.
      b. Thaler Metal Industries Ltd.

B. Description: Manufactured assembly made of 4.0-lb/sq. ft, 0.0625-inch-6.0-lb/sq. ft., 0.0938-inch-thick, lead flashing collar and skirt extending at least 10 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.

2.4 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Deep-Seal Traps:
   1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
   2. Size: Same as connected waste piping.
      a. NPS 2: 4-inch minimum water seal.
      b. NPS 2-1/2 and Larger: 5-inch minimum water seal.

B. Floor-Drain, Trap-Seal Primer Fittings:
   1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
   2. Size: Same as floor drain outlet with NPS 1/2 side inlet.

C. Air-Gap Fittings:
   1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
   2. Body: Bronze or cast iron.
   3. Inlet: Opening in top of body.
   4. Outlet: Larger than inlet.
   5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.
2.5 FLASHING MATERIALS

A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
   1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
   2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.

B. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:
   1. General Applications: 12 oz./sq. ft. thickness.
   2. Vent Pipe Flashing: 8 oz./sq. ft. thickness.

C. Fasteners: Metal compatible with material and substrate being fastened.

D. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

E. Solder: ASTM B 32, lead-free alloy.

F. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

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 cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
   1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
   2. Locate at each change in direction of piping greater than 45 degrees.
   3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
   4. Locate at base of each vertical soil and waste stack.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. 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. Set with grates depressed according to the following drainage area radii:
a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.

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.

F. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.

G. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.

H. Install deep-seal traps on floor drains and other waste outlets, if indicated.

I. 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.

J. Install wood-blocking reinforcement for wall-mounting-type specialties.

K. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:

   1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft, 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
   2. Copper Sheets: Solder joints of copper sheets.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

   1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
   2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
   3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07 Section "Sheet Metal Flashing and Trim."

F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 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.

3.5 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
SECTION 23 01 00 – BASIC MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this and the other sections of Division 23.

1.2 SUMMARY

A. This Section includes general administrative and procedural requirements for mechanical installations. The following administrative and procedural requirements are included in this Section to expand the requirements specified in Division 01:

1. Submittals.
3. Coordination drawings.
4. Record documents.
5. Maintenance manuals.

1.3 SUBMITTALS

A. General: Follow the procedures specified in Division 01.

B. Prepare and submit Coordination Drawings as further described herein. The Engineer shall receive one copy of all coordination drawings supplied to the Owner as required in this specification. It is the responsibility of the Contractor to coordinate the work as outlined herein. Receipt by the Engineer of a copy of the coordination drawings is to verify conformance to the submittal requirements set forth in this specification section. It is not an admission by the Engineer as to the accuracy or completeness of the coordination proposed.

C. Comply with each individual Division 23 Section for additional submittal requirements.

1.4 MATERIAL AND EQUIPMENT SELECTION

A. Product Options: The specification of each item of mechanical equipment required for the project may include a list of manufacturers, with one “basis of design” manufacturer, type, and model identified by virtue of their listing in the equipment schedule on the Drawings. Where several manufacturers in addition to the “basis of design” manufacturer are listed in the specifications, it shall be understood that the words “or approved equal by” are implied to precede each of the other manufacturer’s names.

1. Listed manufacturers other than the “basis of design” may be furnished at the contractor’s option in lieu of the “basis of design” product, provided that the selected manufacturer’s product is equal in all material and functional respects. In addition to submittal requirements that may be specified in this section, submit a line-by-line written verification of the applicable specification section(s) identifying compliance with or variations from the specified features, materials, performance, capacities, weight, size, durability, energy consumption and efficiency, warranty, and visual impact (if exposed to view by other than
maintenance persons). The burden of proof of manufacturer/product equality is on the contractor.

2. Where a product is not scheduled on the drawings and, therefore, where no “basis of design” is indicated, selection among all of the listed manufacturers and products is at the contractor’s option, subject to the requirements of the Contract Documents.

3. Products of manufacturers not listed in the Contract Documents are considered Substitutions and are not permitted, except as provided under the General and Supplementary Conditions and Division 01 Specifications. Full compliance with Division 01 section “Product Substitutions” is mandatory for acceptance of products or manufacturers not listed.

B. Listing of a manufacturer does not imply approval of that manufacturer’s standard product or products. Rather, listing of a manufacturer indicates only a general acceptance of that manufacturer’s name and reputation. Final approval is subject to full compliance with these Contract Documents.

C. Model numbers identified on the Drawings notwithstanding, all equipment must comply with the requirements of these Contract Documents. Do not assume that a manufacturer’s standard product is acceptable as is. For example, one or more custom modifications, custom colors or finishes, manufacturer’s options, and/or accessories may be required to meet the specified requirements.

D. Where drawings indicate sizes, profiles, connections, and dimensional requirements of material and equipment, these are based on the “basis of design” manufacturer, type and model indicated. In the event that equipment of power, dimensions, capacities, layout, connections, and/or ratings differing from the “basis of design” are selected by the contractor and approved by the Owner's representative, any necessary adjustments are the contractor’s responsibility. All connecting mechanical and electrical services, circuit breakers, conduit, motors, bases, pipe and duct sizes, pipe and duct layout, and the like shall be adjusted by the contractor to suit the equipment provided. No additional costs will be approved for these changes. Should revisions to the design because of contractor’s selection of manufacturer, type, or model other than the “basis of design” require additional review and/or redesign by an Architect or Engineer, the contractor shall reimburse the Owner for Owner’s added professional fee expenses.

E. Where two or more materials are listed in the “Part 2 – Products” subsection of any Division 23 section, do not assume that the selection of materials is the contractor’s option. Refer to “Part 3 – Execution” subsection of that same Division 23 section for an explanation of which specific material(s) shall be used for which specific application(s). For example, Part 2 may list several types and grades of piping, and Part 3 will describe which type and grade of pipe to use for a given application.

1.5 COORDINATION DRAWINGS

A. Prepare project coordination drawings to a scale of ¼" = 1’0" or larger. Detail major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. 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:

1. Planned piping layout, including valve and specialty locations and valve-stem movement. Include all piping including but not limited to HVAC piping, plumbing piping, and fire protection piping. Include ceiling and wall-mounted access doors and panels required to provide access to valves and other operating devices.
2. Planned ductwork layout, including terminal units, dampers and specialty locations, with terminal unit and damper operator clearances. Include ceiling and wall-mounted access doors and panels required to provide access to dampers and other operating devices.

3. Clearances for installing and maintaining insulation.

4. Clearances for servicing and maintaining equipment, accessories, and specialties, including space for disassembly required for periodic maintenance.

5. Equipment and accessory service connections and support details.


7. Fire-rated wall and floor penetrations.

8. Sizes and location of required concrete pads and bases.

9. Scheduling, sequencing, movement, and positioning of large equipment into building during construction.

10. Floor plans, elevations, and details to indicate penetrations in floors, walls, ceilings and roofs, and their relationship to other penetrations and installations.

11. Ceiling plans showing coordination of mechanical, electrical, structural, ceiling suspension assembly, lighting, security, communications, fire alarm, plumbing, and fire protection work within allotted space.

12. Reflected ceiling plans to coordinate and integrate installation of air outlets and inlets, light fixtures, communication system components, sprinklers, access panels, special moldings, and other ceiling-mounted items.

13. Floor plans and sections of fan rooms and mechanical rooms; show layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate and certify field measurements.

1.6 RECORD DOCUMENTS

A. Prepare record documents in accordance with the requirements in Division 01. In addition to the requirements specified in Division 01.

1.7 MAINTENANCE MANUALS

A. Prepare maintenance manuals in accordance with Division 01.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION
SECTION 23 05 00 – BASIC MECHANICAL MATERIALS AND METHODS

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 basic mechanical materials and methods to complement other Division 23 Sections.

1. Materials and installation instructions common to mechanical systems.
2. Pipe joining materials and methods.
3. Dielectric fittings.
4. Flexible pipe connectors.
5. Mechanical sleeve seals.
6. Pipe sleeves.
7. Escutcheons.
8. Labeling and identifying mechanical systems and equipment.
10. Painting and finishing of mechanical work.
11. Concrete base construction requirements.
12. Coordination with Structural work.
13. Field-fabricated metal equipment supports.
15. Cutting and patching.

B. Pipe and pipe fitting materials are specified in individual Division 23 piping system Sections.

1.3 DEFINITIONS

A. 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, crawl spaces, and tunnels.

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

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

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

A. Product Data: For dielectric fittings, transition couplings, flexible pipe connectors, mechanical sleeve seals, escutcheons, and identification materials and devices.

B. Shop Drawings: Detail fabrication and installation for metal and wood supports and anchorage for mechanical materials and equipment.

C. Coordination Drawings: For access panel and door locations.

D. Samples: Of color, lettering style, and other graphic representation required for each identification material and device.

E. Welding certificates.

1.5 QUALITY ASSURANCE

A. Comply with ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

B. Welding: Qualify welding processes and operators for structural steel according to AWS D1.1 “Structural Welding Code – Steel.”

C. Welding: Qualify welding processes and operators for piping according to ASME “Boiler and Pressure Vessel Code,” Section IX, “Welding and Brazing Qualifications.”

2. Certify that each welder has passed AWS qualification tests for the welding processes involved and that certification is current.

1.6 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 prevent entrance of dirt, debris, and moisture.

B. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor or roof, if stored thereupon.

C. Protect flanges, fittings, and piping specialties from moisture and dirt.

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

E. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

1.7 SEQUENCING AND SCHEDULING

A. Coordinate mechanical equipment installation with other building components.

B. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction to allow for mechanical installations.
SECTION 23 05 00  
BASIC MECHANICAL MATERIALS AND METHODS

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

D. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning before closing in building.

E. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.

F. Coordinate requirements for access panels and doors if mechanical items requiring access are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section “Access Doors and Panels.”

G. Coordinate installation of identifying devices after completing covering and painting, if devices are applied to surfaces. Install identifying devices before installing acoustical ceilings and similar concealment.

H. Coordinate connection of electrical services.

PART 2 - PRODUCTS

2.1 PIPE AND PIPE FITTINGS

A. Refer to individual Division 23 piping Sections for pipe and fitting materials and joining methods.

2.2 JOINING MATERIALS

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

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

C. Pipe-Flange Joining Gaskets: Suitable for chemical and thermal conditions of piping system contents. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness, unless thickness or specific material is indicated.

1. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
2. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

D. Pipe-Flange Joining Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

E. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

F. Solder Filler Metals: ASTM B32 lead-free alloys. Include water-flushable flex according to ASTM B813.

G. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
Section 2.3 Dielectric Fittings

A. General: Assembly or fitting with insulating material isolating joined dissimilar metals, to prevent galvanic action and stop corrosion.

B. Description: Combination of copper alloy and ferrous, threaded, solder, plain, and weld-neck end types and matching piping system materials.

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

D. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180°F.

E. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.

F. Dielectric-Flange Insulation Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers. Provide separate companion flanges and steel bolts and nuts for 150- or 300-psig minimum working pressure as required to suit system pressures.

G. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225°F.

H. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225°F.

Section 2.4 Flexible Pipe Connectors

A. General: Fabricated from materials suitable for system fluid and that will provide equipment-pipe connections.

B. Flexible Pipe Connectors for Copper Piping: Corrugated bronze inner tubing covered with interwoven bronze wire braid. Include copper-tube ends, brazed to hose.

C. Flexible Pipe Connectors for Steel Piping: Corrugated stainless steel inner tubing covered with interwoven stainless-steel wire braid.
D. Performance Rating Requirements:
1. Misalignment: Rated for ¾-inch permanent lateral offset.
2. Length: As needed to allow offset rating above, but not less than 9-inches.
3. Design Working Pressure: 150 psig at 300°F.

E. Schedule of End Connections:
1. 2-Inch NPS and Smaller, Copper Pipe: Copper tube end connections suitable for soldering to adjacent piping; except that brazed end connections are required for refrigerant service.
2. 2-Inch NPS and Smaller, Steel Pipe: Threaded-end carbon steel nipples welded to hose; except that stainless-steel ends are required for natural gas service or where mated to stainless steel piping.
3. 2½-Inch NPS and Larger: Carbon-steel flanged end connections welded to hose and drilled to meet ANSI Class 150; except that stainless-steel flanged end connections are required for natural gas service or where mated to stainless steel piping.

F. Flexible pipe connectors specified herein are for use at the piping connection to a piece of mechanical equipment, including but not limited to pumps.

2.5 MECHANICAL SLEEVE SEALS
A. Description: Modular design, with interlocking rubber links shaped to continuously fill annular space between pipe and sleeve. Include connecting bolts and pressure plates.

B. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

C. Pressure Plates: Stainless steel. Include two for each sealing element.

D. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.6 PIPE SLEEVES
A. The following sleeve materials are for wall, floor, slab, and roof penetrations.

B. Steel Pipe: ASTM A53, Type E, Grade A, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated “wall pipe” equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
1. Underdeck Clamp: Clamping ring with setscrews.

E. Contractor’s Option: Pre-engineered, UL-listed fire-resistance rated and watertight cast-in-place floor sleeving systems meeting the following specifications will be acceptable in lieu of traditional floor sleeves with field-installed firestop, at contractor’s option.
1. Description: Cast-in-place, factory-assembled, one-piece watertight firestop device for use in concrete floors formed with wood and/or steel decking to protect penetrating objects from expansion and contraction of concrete, thermal and seismic movement, and the passage of air, smoke, fire, and hot gasses.

2. Manufacturer: Subject to compliance with requirements, provide Hydroflame™ sleeving system by Hubbard Enterprises / Holdrite; or approved equal.

3. Include an outer sleeve lined with an intumescent strip; and a radial extended flange attached to one end of the sleeve for fastening to concrete formwork; or wide outside wings attached to one end of the sleeve for fastening to metal deck concrete formwork and span deck corrugations.

4. Include a waterstop gasket and mid-body seal consisting of one to three concentric raised rings for embedment and sealing to the concrete slab. For applications involving a corrugated deck, also include a cone attached to the base for extending the device through the metal deck.

5. Product shall provide a two-hour fire-resistance rated assembly when tested according to ASTM E814 or ANSI/UL 1479.

2.7 ESCUTCHEONS

A. General: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw and polished chrome-plated finish.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw and polished chrome-plated finish.

E. One-Piece, Stamped-Steel Type: With spring clips and chrome-plated finish.

F. Split-Plate, Stamped-Steel Type: With concealed hinge, spring clips, and chrome-plated finish.

G. One-Piece, Floor-Plate Type: Cast-iron floor plate.

H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.8 IDENTIFYING DEVICES AND LABELS

A. General: Manufacturer’s standard products of categories and types required for each application as referenced in other Division 23 Sections. If more than one type is specified for application, selection is installer’s option, but provide one selection for each product category.

B. Equipment Nameplates: Metal nameplate with operational data engraved or stamped; permanently fastened to equipment; furnished and factory-installed by original equipment manufacturer.

1. Data: Manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data.
2. Location: Accessible and visible location.

C. Pressure-Sensitive Pipe Markers: Manufacturer’s standard preprinted, permanent adhesive, color-coded, pressure-sensitive vinyl, complying with ASME A13.1.

D. Plastic Duct Markers: Manufacturer’s standard color-coded, laminated plastic. Comply with the following color code:

1. Green: Cold air.
2. Yellow: Hot air.
3. Yellow/Green or Green: Supply air.
4. Blue: Exhaust, outside, return, and mixed air.
5. Nomenclature: Include direction of airflow and duct service.

E. Engraved Plastic-Laminate Signs: ASTM D709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated.

1. Fabricate in sizes required for message.
2. Engraved with engraver’s standard letter style, of sizes and with wording to match equipment identification.
3. Punch for mechanical fastening.
4. Thickness: 1/16-inch, for units up to 20 sq. in. or 8 inches long; 1/8-inch for larger units.
5. Fasteners: Self-tapping stainless-steel screws or contact-type permanent adhesive.

F. Valve Tags: Stamped or engraved with ¼-inch letters for piping system abbreviation and ½-inch sequenced numbers. Include 5/32-inch hole for fastener.

1. Material: 3/32-inch thick plastic laminate with 2 black surfaces and a white inner layer.
2. Size: 1½-inches diameter, unless otherwise indicated.

G. Valve Tag Fasteners: Brass, wire-link chain; beaded chain; or S-hooks.

H. Lettering and Graphics: Coordinate names, abbreviations, and other designations used in mechanical identification, with corresponding designations indicated. Use numbers, lettering, and wording indicated for proper identification and operation/maintenance of mechanical systems and equipment.

1. Multiple Systems: If multiple systems of same generic name are indicated, provide identification that indicates individual system number and service such as “Boiler No. 3,” “Air Supply No. 1H,” or “Standpipe F12.”

2.9 PAINTING AND FINISHING

A. For all painting and finishing work required for mechanical installations, as described in Part 3 of this Section and/or on the Drawings, refer to Division 09 Sections for specification of paint and finishing materials, whose requirements apply to the work of Division 23 as if fully reproduced herein.
A. Material Compatibility: Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.

B. Colors: As directed by Owner’s representative.

PART 3 - EXECUTION

3.1 GENERAL MECHANICAL INSTALLATION REQUIREMENTS

A. General: Sequence, coordinate, and integrate the various elements of mechanical systems, materials, and equipment. Comply with the following requirements.

B. Coordinate mechanical systems, equipment, and materials installation with other building components.

C. Verify all dimensions by field measurements.

D. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for mechanical installations.

E. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.

F. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.

G. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.

H. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.

I. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Architect.

J. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.

K. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.

L. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.
3.2 PIPING SYSTEM INSTALLATION REQUIREMENTS

A. General: Install piping as described below, unless piping Sections specify otherwise. Individual Division 23 piping Sections specify unique piping installation requirements.

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

C. Install piping at indicated slope.

D. Install and arrange piping to permit valve servicing.

E. Install components with pressure rating equal to or greater than system operating pressure.

F. Install piping in concealed interior and exterior locations, except in equipment rooms and service areas.

G. Install piping free of sags and bends.

H. Install exposed interior and exterior piping at right angles or parallel to building walls. Diagonal runs are prohibited, unless otherwise indicated.

I. Install piping tight to slabs, beams, joists, columns, walls, and other building elements. Allow sufficient space above removable ceiling panels to allow for ceiling panel removal.

J. Electrical Equipment Spaces: Route piping to avoid passing through transformer vaults and electrical equipment spaces and enclosures.

K. Install piping to allow application of insulation plus 1-inch clearance around insulation.

L. Locate groups of pipes parallel to each other, spaced to permit valve servicing.

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

N. Install couplings according to manufacturer’s written instructions.

O. Piping Support: As specified in Division 23 Section “Hangers and Supports.”

3.3 PIPING JOINING REQUIREMENTS

A. Piping Joint Construction: Join pipe and fittings as follows and as specifically required in individual piping specification Sections.

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 B813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B828 or CDA’s “Copper Tube Handbook,” using lead-free solder alloy complying with ASTM B32.

E. 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.

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. Note internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
2. Apply appropriate tape or thread compound to external pipe threads, unless dry seal threading is specified.
3. Align threads at point of assembly.
4. Tighten joint with wrench. Apply wrench to valve end into which pipe is being threaded.
5. 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.


1. Apply one coat of self-priming, rust-inhibitor paint around the entire circumference of each welded pipe joint; regardless of whether or not the piping is specified to be painted. Paint may be brush-applied, roller-applied, or spray-applied at contractor’s option.

H. Flanged Joints: Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.

I. Piping Connections: Make connections according to the following, unless otherwise indicated.

1. Install unions, in piping 2-inch NPS and smaller, adjacent to each valve and at final connection to each piece of equipment with 2-inch NPS or smaller threaded pipe connection.
2. Install flanges, in piping 2½-inch NPS and larger, adjacent to flanged valves and at final connection to each piece of equipment with flanged pipe connection.
3. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.
4. Valve Caps: Any valve that represents a termination or the end of a run (e.g., blowdown or drain valve, hose-end valve, etc.) shall be fitted with a permanent but removable cap, plug, or blind flange matching the valve construction, to minimize risk in the event the valve is accidentally opened under pressure.

3.4 PIPE-PENETRATION INSTALLATION REQUIREMENTS

A. Install escutcheons for new piping penetrations of walls, ceilings, and floors according to the following:
1. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
2. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
3. Insulated Piping: One-piece, stamped-steel type with spring clips.
4. Uninsulated Piping in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
5. Uninsulated Piping in Unfinished Spaces: One-piece, cast-brass type.
6. Uninsulated Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

B. Install escutcheons for existing piping penetrations of new walls, ceilings, and floors. Match type, material, and finish as specified for new piping, except that split-casting or split-plate type will be accepted in lieu of one-piece.

C. Install sleeves for pipes passing through concrete and masonry walls, and concrete floor and roof slabs.

D. Cut sleeves to length for mounting flush with both surfaces. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

E. Fire-Resistance Rated, Cast-in-Place Sleeve Installation: Select sleeve size based on size and type of pipe and thickness of the floor. Position and secure sleeve to concrete form using nails or staples. Place concrete, and finish even with top of sleeve. Install in complete and strict accordance with manufacturer's UL-listed installation instructions.

F. Build sleeves into new walls and slabs as work progresses.

G. Install sleeves large enough to provide ¼-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

   1. Steel Pipe Sleeves: For pipes smaller than 6-inch NPS.
   2. 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 “Flashing and Sheet Metal” for flashing.
   3. Seal space outside of sleeve fittings with nonshrink, nonmetallic grout.

H. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using elastomeric joint sealants. Refer to Division 07 Section “Joint Sealants” for materials. Use Type S, Grade NS, Class 25, Use O, neutral-curing silicone sealant, unless otherwise indicated.

I. Aboveground, Exterior-Wall, Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

   1. Install steel pipe for sleeves smaller than 6 inches in diameter.
   2. Install cast-iron "wall pipes" for sleeves 6 inches in diameter and larger.
   3. Assemble and install mechanical sleeve seals according to manufacturer's written instructions. Tighten bolts that cause rubber-sealing elements to expand and make watertight seal.
J. Underground, Exterior-Wall, Pipe Penetrations: Install cast-iron “wall pipes” for sleeves. Seal pipe penetrations using mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals. Assemble and install mechanical sleeve seals according to manufacturer’s written instructions. Tighten bolts that cause rubber-sealing elements to expand and make watertight seal.

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

L. Permanent sleeves are not required for holes formed by PE removable sleeves.

M. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestopping materials. Refer to Division 07 Section “Penetration Firestopping” for materials.

3.5 EQUIPMENT INSTALLATION REQUIREMENTS

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

B. Refer to equipment specifications in Division 23 and Division 26 for rough-in requirements.

C. Install equipment to provide maximum possible headroom, if mounting heights are not indicated.

D. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to Architect.

E. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

F. Positive attachment and anchorage of all equipment to the structure or floor is required. Do not rely on friction or gravity as a means of attachment.

G. Install mechanical 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.

H. Install equipment giving right of way to piping installed at required slope.

I. Install flexible pipe connectors at the following locations. Install on equipment side of shutoff valves.

1. Inlet and outlet of each pump.
2. At each connection to a packaged computer-room air-conditioning unit.
3. Where indicated elsewhere in these specifications.

J. Support for Suspended Equipment: As specified in Division 23 Section “Hangers and Supports.”
3.6 LABELING AND IDENTIFYING

A. Piping Systems: Install pipe markers on each system. Include arrows showing normal direction of flow. Use plastic markers, with application systems. Install on insulation segment if required for hot, uninsulated piping.

B. Locate pipe markers as follows if piping is exposed in finished spaces, machine rooms, and accessible maintenance spaces, such as shafts, tunnels, plenums, and exterior nonconcealed locations:

1. Near each valve and control device.
2. Near each branch, excluding short takeoffs for fixtures and terminal units. Mark each pipe at branch, if flow pattern is not obvious.
3. Near locations where pipes pass through walls, floors, ceilings, or enter nonaccessible 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 of 50-foot intervals along each run. Reduce intervals to 25 feet in congested areas of piping and equipment.
7. On piping above removable acoustical ceilings, except omit intermittently spaced markers.

C. Install continuous plastic underground warning tapes during back filling of trenches for underground piping. Locate 6 to 8 inches below finished grade, directly over piping. Refer to Division 31 Section “Earth Moving” for warning-tape materials and devices and their installation.

D. Equipment: Install engraved plastic-laminate sign on or near each major item of mechanical equipment.

1. Lettering Size: Minimum ¼-inch- high lettering for name of unit if viewing distance is less than 24 inches, ½-inch- high lettering for distances up to 72 inches, and proportionately larger lettering for greater distances. Provide secondary lettering two-thirds to three-fourths of size of principal lettering.
2. Text of Signs: Provide name of identified unit. Include text to distinguish between multiple units, inform user of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

E. Duct Systems: Identify air supply, return, exhaust, intake, and relief ducts with duct markers showing duct system service and direction of flow. In each space, if ducts are exposed or concealed by removable ceiling system, locate signs near points where ducts enter into space and at maximum intervals of 50 feet.

F. Adjusting: Relocate identifying devices as necessary for unobstructed view in finished construction.

G. Install valve tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, plumbing fixture supply stops, faucets, and similar roughing-in connections of end-use fixtures and units.

3.7 PAINTING AND FINISHING

A. For all painting and finishing work required for mechanical installations, refer to Division 09 Sections for application requirements.
B. Painting HVAC Work: Paint the following work where exposed to view in finished or unfinished spaces: uninsulated steel piping, pipe hangers and supports, tanks that do not have factory-applied final finishes, all interior and exterior ferrous piping and appurtenances, including steel, galvanized steel, cast iron and ductile iron.

C. In addition, paint the following:
   1. Duct, equipment, and pipe insulation having ASJ or other paintable jacket material.
   2. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

D. Steel Substrates: Primer, alkyd, anti-corrosive, for metal, MPI #79; plus topcoat of latex, interior, semi-gloss, MPI #54.

E. Galvanized-Metal Substrates: Primer, galvanized, water based, MPI #134; plus topcoat of latex, interior, semi-gloss, MPI #54.

F. Aluminum (Not Anodized or Otherwise Coated) Substrates: Primer, quick dry, for aluminum, MPI #95; plus topcoat of latex, interior, semi-gloss, MPI #54.

G. ASJ Insulation-Covering Substrates: Including pipe and duct coverings. Primer sealer, latex, interior, MPI #50; plus topcoat of latex, interior, semi-gloss, MPI #54.

H. Primers specified above may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

3.8 COORDINATION WITH STRUCTURAL WORK

A. Concrete: Do not embed pipes, wires, tube, boxes, ducts or other cavity-creating elements in concrete work unless shown on or permitted by the structural drawings. Openings through concrete not shown on the structural drawings are subject to approval by the structural engineer of record. See coordination drawing requirements under Submittals.

B. Roof Deck: Do not place loads on, or hang any loads whatsoever from roof deck, unless shown on structural drawings, including, but not limited to, hangers for pipes, ducts, equipment, etc. Trade contractor installing such loads shall provide sub-framing connected to steel frame.
   1. Do not exceed capacity of roof deck as a working platform. Submit all proposed construction loads to deck supplier for approval.
   2. Openings in roof deck not shown on structural drawings, such as openings required for stacks, pipes, ducts, plumbing vents, etc., shall be cut and reinforced by trade requiring opening.

C. Supported Slab: Do not suspend loads exceeding 500 pounds within any 100 square feet of contiguous area from concrete supported slab. Suspend such loads from structural steel only. Any “sub-framing” required is responsibility of Contractor or sub-contractor installing material requiring support.
   1. Openings in concrete floor slabs not shown on structural drawings, such as openings required for stacks, pipes, ducts, plumbing vents, etc., shall be the
responsibility of the trade requiring openings. Form blockouts in the slab, 
reinforcing deck, and cut openings after concrete has reached specified strength.
2. Where openings larger than 12-inches are required but not shown on structural 
drawings, secure written approval from Architect/Engineer prior to cutting deck.

3.9 ERECTION OF METAL SUPPORTS AND ANCHORAGE

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and 
elevation to support and anchor mechanical materials and equipment.


3.10 SELECTIVE DEMOLITION

A. Disconnect, demolish, and remove mechanical work as indicated on the Drawings, and 
as required for installation of new work shown. Coordinate with Division 26 for 
disconnection of power to electrically-powered equipment prior to demolition.

B. Remove accessible work in its entirety. Repair cut surfaces to match adjacent surfaces. 
Abandon in place embedded or buried work, unless noted otherwise.

1. Piping to Be Removed: Remove portion of piping indicated to be removed and 
cap or plug remaining piping with same or compatible piping material.
2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same 
or compatible piping material.
3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and 
plug remaining ducts with same or compatible ductwork material.
4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible 
ductwork material.
5. Equipment to Be Removed: Disconnect and cap services and remove 
equipment.

C. Removal: Unless otherwise indicated, remove demolished pipe, duct and equipment from 
the Project site. Handle and dispose of in accordance with National, State, and Local 
regulations.

1. Relocation: Remove, store, clean, reinstall, reconnect, and make operational all 
work indicated for relocation.
2. Salvage: Remove and deliver to Owner all work indicated for salvage.

D. Refer to Division 01 Sections “Selective Demolition” and/or “Selective Structure 
Demolition” for additional requirements.

E. For selective demolition of any appliance or piece of equipment containing a CFC, HCFC, 
or HFC refrigerant: Prior to demolition, refrigerant shall be evacuated and captured in full 
compliance with the Clean Air Act; using only technicians with the proper refrigerant 
license as according to law, stored in approved containers, and shipped to a licensed 
refrigerant recycling facility all as required by the United States Environmental Protection 
Agency.
3.11 CUTTING AND PATCHING

A. General: Employ skilled workmen to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time and complete without delay. Perform cutting and patching in accordance with the following:

B. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.

C. Perform cutting, fitting, and patching of mechanical equipment and materials required to:

1. Uncover Work to provide for installation of ill-timed Work.
2. Remove and replace defective Work.
3. Remove and replace Work not conforming to requirements of the Contract Documents.
4. Install equipment and materials in existing structures.

D. Cut, remove and legally dispose of selected mechanical equipment, components, and materials as indicated, including but not limited to removal of mechanical piping, pumps, and other mechanical items made obsolete by the new Work.

E. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for mechanical installations. Perform cutting by skilled mechanics of trades involved.

F. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

G. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

H. Repair cut surfaces to match adjacent installations.

I. Repair any building insulation or building fireproofing materials, whether new or existing, that are removed or scraped away in order to make a mechanical installation, so as to maintain an equivalent insulation or fire rating as existed without said mechanical installation.

J. Refer to Division 01 Sections “Execution” and/or “Cutting and Patching” for additional requirements.

END OF SECTION
SECTION 23 05 13 – MOTORS

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 basic requirements for factory-installed motors associated with mechanical equipment specified elsewhere in Division 23.

B. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer’s factory or shipped separately by equipment manufacturer for field installation.

C. Related Sections include all other Division 23 Sections for application of motors and reference to specific motor requirements for motor-driven equipment.

1.3 SUBMITTALS

A. Product Data: Submit motor product data with each associated equipment submittal. Show nameplate data and ratings; characteristics; mounting arrangements; size and location of winding termination lugs, conduit entry, and grounding lug; and coatings.

1.4 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. UL Listing: Motors specified in this Section must be listed and labeled by Underwriters Laboratories and bear the UL logo.

1.5 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices and features that comply with the following:

1. Compatible with magnetic controllers, multi-speed controllers, and/or reduced-voltage controllers where applicable.

2. Designed and labeled for use with variable frequency controllers where applicable and suitable for use throughout speed range without overheating.

3. Matched to torque and horsepower requirements of the load.

4. Matched to ratings and characteristics of supply circuit and required control sequence.

B. Coordinate motor support with requirements for driven load; access for maintenance and motor replacement; installation of accessories, belts, belt guards; and adjustment of sliding rails for belt tensioning.
PART 2 - PRODUCTS

2.1 BASIC MOTOR REQUIREMENTS

A. Basic requirements apply to mechanical equipment motors, unless otherwise indicated.

B. Motors Larger than 1 HP: Polyphase.

C. Motors 1HP and Smaller: Single phase.

D. Frequency Rating: 60 Hz.

E. Voltage Rating: NEMA standard voltage selected to operate on nominal voltage of circuit to which motor is connected.

F. Service Factor: According to NEMA MG 1, unless otherwise indicated, but at least 1.15 polyphase motors and 1.35 for single-phase motors.

G. Duty: Continuous duty at ambient temperature of 104°F and at altitude of 3300 ft above sea level.

H. Capacity and Torque Characteristics: Rated for continuous duty and sufficient to start, accelerate, and operate connected loads at designated speeds, in indicated environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

I. Enclosure: Open drip-proof, unless otherwise indicated.

2.2 POLYPHASE MOTORS

A. Description: NEMA MG 1, medium induction motor.

B. Design Characteristics: NEMA MG 1, Design E, unless otherwise indicated.

C. Energy-Efficient Design: Premium efficiency motors as defined in NEMA MG 1; Part 31. In addition, motors shall meet efficiency levels defined in Tables 12-12 and 12-13 of MG 1-2006.

D. Stator: Copper windings, unless otherwise indicated.

E. Rotor: Random-wound, squirrel cage, unless otherwise indicated.

F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

G. Temperature Rise: Match insulation rating, unless otherwise indicated.

H. Insulation: Class F, unless otherwise indicated.

I. Code Letter Designation:
   1. Motors 15 HP and larger: NEMA starting Code F or Code G.
   2. Motors under 15 HP: Manufacturer's standard starting characteristics.
J. Enclosure: Cast iron for motors 7½ HP and larger; rolled steel for motors smaller than 7½ HP; with enamel finish.

K. Motor efficiencies for motors larger than one horsepower shall be as indicated in the table below, but in no case shall be less efficient than “Premium Efficiency” as defined in NEMA MG 1; Part 31. Motors shall be tested and labeled in accordance with NEMA MG 1-2006 Part 12 Table 12-12 Standard. Motor nameplate labeling shall include both the minimum and nominal efficiency.

L. Motors Used with Reduced-Inrush Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

M. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

   1. Designed with critical vibration frequencies outside operating range of controller output.
   2. Temperature Rise: Matched to rating for Class B insulation.
   3. Insulation: Class F or H.
   4. Motor shall be inverter-duty or inverter-ready and shall not require the use of external cooling fans.

N. Shaft Grounding Ring: On any and all motors to be controlled by a Variable Frequency Motor Controller, include an engineered ring consisting of two or more rows of circumferential conductive microfibers to redirect shaft current and provide a low-impedance path from shaft to frame, bypassing the motor bearings. Factory-install on the motor shaft by sliding the ring over either end, and lock it in place with mechanically-fastened mounting brackets. Motors over 100 nameplate horsepower shall be provided with an insulated bearing on the non-drive end and a shaft grounding ring on the drive end of the motor. Product shall be “Aegis SGR” by Electro Static Technology or approved equal.

O. Multispeed Motors: Variable torque.

   1. For motors with 2:1 speed ratio, consequent pole, single winding.
   2. For motors with other than 2:1 speed ratio, separate winding for each speed.

P. Source Quality Control: Perform the following routine tests according to NEMA MG 1:

   1. Measurement of winding resistance.
   2. No-load readings of current and speed at rated voltage and frequency.
   3. Locked rotor current at rated frequency.
   4. High-potential test.
   5. Alignment.

2.3 SINGLE-PHASE MOTORS

A. Type: As indicated or selected by manufacturer from one of the following, to suit starting torque and other requirements of specific motor application.

   1. Permanent-split capacitor.
   2. Split-phase start, capacitor run.
   3. Capacitor start, capacitor run.
B. Shaded-Pole Motors: Do not use, unless motors are smaller than 1/20 hp.

C. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

D. Thermal Protection: Where indicated or required, internal protection shall 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, unless otherwise indicated.

E. Bearings: Ball-bearing type for belt-connected motors and other motors with high radial forces on motor shaft. Sealed, pre-lubricated sleeve bearings for other single-phase motors.

2.4 ELECTRICALLY-COMMUTATED MOTORS

A. General: Electrically-Commutated Motors (ECM) are required wherever indicated in other Division 23 Specifications and/or notations on the Drawings.

B. Motor: Motor shall be ECM, variable-speed, DC type, brushless motor designed for fan applications with heavy duty permanently lubricated ball bearings and electric commutation. It shall contain internal circuitry that converts single phase power into a DC signal. Motor shall be designed for direct-drive applications.

C. Speed Control: The ECM shall be speed-controllable down to 20% of full speed via exterior-mounted field-adjustable potentiometer dial or DDC control signal input.

D. Efficiency: Minimum 70% at all speeds.

E. Voltage: Single-phase as indicated.

F. Rotor: Synchronous; permanent magnet type; built-in soft start.

G. Thermal Protection: Where indicated or required, internal protection shall 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, unless otherwise indicated.
PART 3 - EXECUTION

3.1 INSTALLATION, ALL MOTORS

A. Use adjustable motor mounting bases for belt-driven motors.

B. Align motors, bases, shafts, pulleys, and belts. Tension belts according to manufacturer’s written instructions.

C. Verify bearing lubrication.

D. Run each motor with its controller. Demonstrate correct rotation, alignment, and speed at motor design load.

E. Test interlocks and control and safety features for proper operation.

F. Verify that current and voltage for each phase comply with nameplate rating and NEMA MG 1 tolerances.

G. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

END OF SECTION
SECTION 23 05 19 – METERS AND GAGES

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. Liquid-in-glass thermometers.
2. Thermowells.
3. Pressure gages.
4. Test plugs.

1.3 SUBMITTALS

A. Product Data: Submit product data for each type of meter, gage, and fitting specified. Include scale range, ratings, and calibrated performance curves. Submit a meter and gage schedule showing manufacturer's figure number, scale range, location, and accessories for each meter and gage.

B. Product Certificates: For each type of meter and gage, from manufacturer.

C. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Comply with applicable portions of American Society of Mechanical Engineers (ASME) and Instrument Society of America (ISA) standards pertaining to construction and installation of thermometers and gages.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Thermometers and Pressure Gages:
   a. Ernst Gage Co.
   b. Marsh Bellofram.
   c. Miljoco Corp.
   d. H.O. Trerice Co.
   e. Weiss Instruments, Inc.
   f. Weksler Glass Thermometer Corp.
2. Test Plugs:
   b. Miljoco Corporation.
   c. Peterson Equipment Co., Inc.
   d. Sisco Manufacturing Company, Inc.
   e. H.O. Trerice Co.
   f. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
   g. Weiss Instruments, Inc.

2.2 LIQUID-IN-GLASS THERMOMETERS

B. Case: Cast aluminum; 9-inch nominal size unless otherwise indicated.
C. Case Form: Adjustable angle; 180-degree adjustment in vertical plane, 360-degree adjustment in horizontal plane, with locking device
D. Tube: Glass with magnifying lens and blue organic mineral spirit fill.
E. Tube Background: Non-reflective aluminum with enameled scale markings graduated in both degrees F and degrees C.
F. Scale range: Temperature ranges for services listed as follows:
   1. Heating Hot Water: 30°F to 240°F, with 2-degree scale divisions
   2. Chilled Water: 0°F to 100°F, with 2-degree scale divisions.
   3. Steam and Steam-Condensate Piping: 50 to 400°F, with 5-degree scale divisions
   4. Air Ducts: -40 to +160°F, with 2-degree scale divisions.
G. Window: Glass, acrylic, or Lexan.
H. Stem: Stainless steel for separable socket, and of length to suit installation.
   2. Design for Thermowell Installation: Bare stem.
I. Connector: 1¼ inches, with ASME B1.1 screw threads.
J. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.3 DUCT-THERMOMETER MOUNTING BRACKETS

A. Description: Flanged bracket with screw holes, for attachment to air duct and made to hold thermometer stem.

2.4 THERMOWELLS

B. Description: Pressure-tight, socket-type fitting with protective dry well made for insertion into piping threaded tee fitting.

C. Material for Use with Copper Tubing: Brass.

D. Material for Use with Steel Piping: Stainless steel.

E. Type: Stepped shank unless straight or tapered shank is indicated.

F. External Threads: NPS ½, NPS ¾, or NPS 1, ASME B1.20.1 pipe threads.

G. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.

H. Bore: Diameter required to match thermometer bulb or stem.

I. Insertion Length: Length required to match thermometer bulb or stem, to extend to center of pipe.

J. Lagging Extension: Nominal thickness of 2 inches, but not less than thickness of insulation. Omit extension neck for wells for piping not insulated.

K. Bushings: For converting size of thermowell’s internal screw thread to size of thermometer connection.

L. Cap: Threaded, with chain permanently fastened to socket.

M. Heat-Transfer Medium: Oil, conductive jelly, or mixture of graphite and glycerin.

2.5 PRESSURE GAGES

A. Description: ASME B40.1, Grade A phosphor-bronze Bourdon-tube pressure gage with bottom connection; dry type, unless liquid-filled-case type is indicated.

1. Pressure gages serving pump differential measurement shall be liquid-filled.

B. Case: Drawn steel, brass, or aluminum with 4½-inch-diameter glass lens.

C. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.

D. Pressure Connection: Brass, with NPS ¼ ASME B1.20.1 pipe threads.

E. Movement: Mechanical, with link to pressure element and connection to pointer.

F. Dial: Nonreflective aluminum with enameled scale markings graduated in dual units of psi and kPa.

G. Pointer: Dark-colored metal.

H. Window: Glass, acrylic, or Lexan lens.

I. Ring: Brass or Stainless steel.

J. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.
K. Range: Comply with the following:
   1. Vacuum: 30 inches Hg of vacuum to 15 psig of pressure.
   2. Fluids under Pressure: Two times the operating pressure.

L. Gage Attachments:
   1. Snubbers: ASME B40.100, brass; with NPS ¼, ASME B1.20.1 pipe threads and porous-metal-type surge-dampening device of material suitable for system fluid and working pressure. Include extension for use on insulated piping.
   2. Siphons: Loop-shaped section of brass or stainless-steel pipe with NPS ¼ pipe threads.
   3. Valves: Brass or stainless-steel needle-type, with NPS ¼, ASME B1.20.1 pipe threads. Ball valves are not acceptable.
   4. Trumpet Valve: NPS ¼ brass or stainless-steel type with 4 ports and 4 cocks, such that the pressure differential between any two ports can be indicated.

2.6 TEST PLUGS

A. Description: Test-station fitting made for insertion into piping tee fitting.

B. Body: Brass or stainless steel with core inserts. Include extended stem on units to be installed in insulated piping, with length as required to extend beyond insulation.

C. Test-Plug Cap: Gasketed and threaded cap, with retention chain.

D. Thread Size: NPS ½, ASME B1.20.1 pipe thread.

E. Minimum Pressure and Temperature Rating: 500 psig at 200°F.

F. Core Inserts: Two (2) EPDM self-sealing rubber valve types, suitable for inserting a 1/8-inch outside-diameter probe from a dial thermometer or pressure gage.

G. Furnish one test-plug kit(s) containing two thermometer(s), one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.
   1. Low-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch-diameter dial and tapered-end sensing element. Dial range shall be at least 25 to 125°F.
   2. High-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch-diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220°F.
   3. Pressure Gage: Small, Bourdon-tube insertion type with 2- to 3-inch- diameter dial and probe. Dial range shall be at least 0 to 200 psig.
   4. Carrying Case: Metal or plastic, with formed instrument padding.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install thermowells 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 duct-thermometer mounting brackets in walls of ducts. Attach to duct with screws.

G. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

H. Install valve and snubber in piping for each pressure gage for fluids (except steam).

I. Install valve and siphon fitting in piping for each pressure gage for steam.

J. Install test plugs in piping tees where indicated, located on pipe at most readable position. Secure cap.

K. Install thermometers in the following locations:
   1. Inlet and outlet of each hydronic coil in blower coil units.
   2. Outside-, return-, supply-, and mixed-air ducts.

L. Install pressure gages in the following locations:
   1. Where indicated on Drawings.

3.2 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

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.

END OF SECTION
SECTION 23 05 23 – VALVES

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 general-duty valves common to Division 23 mechanical piping systems:

1. Ball valves.
2. Butterfly valves.

1.3 SUBMITTALS

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

B. Maintenance Data: For each type of valve, to include in the operation and maintenance manual specified in Division 01. Include detailed manufacturer’s instructions on adjusting, servicing, disassembling, and repairing.

1.4 QUALITY ASSURANCE

A. ASME Compliance: ASME B31.9 for building services piping valves.

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

C. MSS Compliance: Comply with the various MSS Standard Practice documents referenced herein.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
4. Set butterfly valves closed or slightly open.
5. Block check valves in either closed or open position.

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.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. General: Subject to compliance with requirements, provide valves by one of the following:

1. Crane Co.; Crane Valve Group; Center Line brand.
5. Milwaukee Valve Company.
6. NIBCO Inc.

2.2 VALVES, COMMON REQUIREMENTS

A. General: Refer to Part 3 “Valve Applications Schedule” Article for application schedule of valves, end connections, and actuator types.

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

C. Valve Bypass and Drain Connections: MSS SP-45.

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

E. For piping systems required to be insulated, valve stems shall be extended to accommodate insulation. Refer to other Division 23 Sections for piping systems required to be insulated.

F. Operators: Provide the following special operator features:

1. Handwheel fastened to valve stem, for valves other than quarter turn.
2. Lever handles, on quarter turn valves 6 inch and smaller.

G. End Connections: As indicated in the valve specifications.


2.3 BALL VALVES

A. Ball Valves, 1 Inch and Smaller; MSS SP-110; Rated for 150 psi saturated steam pressure, 600 psi WOG pressure; two piece construction; with bronze body conforming to
ASTM B 62, standard (or regular) port, chrome plated brass ball, replaceable "Teflon" or "TFE" seats and seals, blowout proof stem, and vinyl covered steel handle. Provide solder ends for condenser water, chilled water, and domestic hot and cold water service; threaded ends for heating hot water.

B. Ball Valves, 1-1/4" and to 2": Rated for 150 psi saturated steam pressure, 600 psi WOG pressure; 3 piece construction; with bronze body conforming to ASTM B 62, conventional port, chrome plated brass ball, replaceable "Teflon" or "TFE" seats and seals, blowout proof stem, and vinyl covered steel handle. Provide solder ends for condenser water, chilled water, and domestic hot and cold water service; threaded ends for heating hot water.

2.4 BUTTERFLY VALVES

A. Butterfly Valves, 2 1/2 Inch and Larger: MSS SP 67; rated at 200 psi; cast iron body conforming to ASTM A 126, Class B. Provide valves with field replaceable EPDM sleeve, aluminum bronze disc, stainless steel stem, and EPDM O ring stem seals. Provide lever operators with locks and memory stops for sizes 2 through 6 inches and gear operators with position indicator for sizes 8 through 24 inches. Provide lug or wafer type as indicated. Lug-type valves on dead end service or requiring additional body strength.

PART 3 - EXECUTION

3.1 EXAMINATION

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

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

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

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

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

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

3.2 VALVE INSTALLATION

A. Install valves as indicated, according to manufacturer’s written instructions.

B. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

C. Install isolation valves at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
D. Locate valves for easy access and provide separate support where necessary.

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

F. Install valves in position to allow full stem movement.

G. Any valve that represents a termination or the end of a run (e.g., blowdown or drain valve, hose-end valve, etc.) shall be fitted with a permanent but removable cap, plug, or blind flange matching the valve construction, to minimize risk in the event the valve is accidentally opened under pressure.

3.3 JOINT CONSTRUCTION

A. Refer to Division 23 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.

B. Threaded Connections: Note the 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.
   1. Align threads at point of assembly.
   2. Apply appropriate tape or thread compound to the external pipe threads, except where dry seal threading is specified.
   3. Assemble joint, wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.

C. Flanged Connections: Align flange surfaces parallel.
   1. 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.
   2. For dead-end service, butterfly valves require flanges both upstream and downstream for proper shutoff and retention.

3.4 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.

3.5 VALVE APPLICATIONS SCHEDULE

A. General: Refer to piping Sections and Drawings for specific valve applications. If no specific valve type is indicated, use the valve types indicated in the following schedules.

B. HVAC Chilled Water, Hydronic Heating Water Piping, HVAC Makeup Water and Drain Piping: Use the following types of valves. Choices are contractor’s option unless a specific type of valve is specifically called out by name on the Drawings.
   1. For shutoff duty, NPS 2 and smaller, use ball valves.
   2. For shutoff duty, NPS 2½ and larger, use butterfly valves.
   3. For throttling duty, NPS 2 and smaller, use ball valves or globe valves.
   4. For throttling duty, NPS 2½ and larger, use butterfly valves or globe valves.

END OF SECTION
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 hangers and supports for mechanical system piping and equipment, including but not limited to the following:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Equipment supports.

B. Related Sections include the following:

1. Division 05 Sections for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports; and for materials for attaching hangers and supports to building structure.
2. Division 23 Section “Metal Ducts” for duct hangers and supports.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

B. Terminology: As defined in MSS SP-90, “Guidelines on Terminology for Pipe Hangers and Supports.”

1.4 PERFORMANCE REQUIREMENTS

A. If contractor elects to apply channel support systems and/or heavy-duty steel trapezes to support multiple pipes, in lieu of individual supports, then contractor is responsible for design of same capable of supporting combined weight of supported systems, system contents, and test water.

1. Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. Do not suspend pipe hangers and supports from roof deck. Suspend such loads from structural steel only, and provide structural steel sub-framing as required.
D. Do not suspend piping loads exceeding 500 pounds within any 100 square feet of contiguous area from supported concrete floor slabs. Suspend such loads from structural members only, and provide structural steel sub-framing as required.

E. Structural Performance: Hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1.5 SUBMITTALS

A. Product Data: For each type of pipe hanger, channel support system component, and thermal-hanger shield insert indicated. Include:

1. Metal pipe hangers and supports.
2. Thermal-hanger shield inserts.
3. Fastener systems.
4. Equipment supports.
5. Trapeze pipe hangers. Include Product Data for components.
6. Metal framing systems. Include Product Data for components.

B. Shop Drawings: Signed and sealed shop drawings by a qualified professional engineer are required for all custom pipe and equipment hangers and supports. Show fabrication and installation details and analysis data, and include calculations.

C. Welding certificates.

1.6 QUALITY ASSURANCE


B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code, Section IX, “Welding and Brazing Qualifications.”

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Manufactured Pipe Hangers:
   a. Anvil International, Inc.
   b. Cooper B-Line, Inc.
   c. Carpenter & Patterson, Inc.
   d. Erico International Corp.
   e. PHD Manufacturing, Inc.
   f. Tolco division of Cooper B-Line, Inc.

2. Metal Framing Systems:
   a. Anvil International, Inc.
   b. Cooper B-Line, Inc.
   c. Erico / Michigan Hanger Co.
d. Thomas & Betts Corporation.
e. Tolco division of Cooper B-Line, Inc.
f. Unistrut Corporation; Tyco International, Ltd.

3. Thermal-Hanger Shield Inserts:
   a. Carpenter & Paterson, Inc.
   b. Erico International Corp.
   c. PHS Industries, Inc.
   d. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.

4. Powder-Actuated Fastener Systems:
   a. Hilti, Inc.
   b. ITW Ramset/Red Head.

2.2 METAL PIPE HANGERS AND SUPPORTS

A. Application: Refer to “Hanger and Support Applications” Article in Part 3 for where to use specific hanger and support types.

B. 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.
   5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel unless noted otherwise.

2.3 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.

2.4 METAL FRAMING SYSTEMS

A. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes, according to Standard MFMA-4.

B. Channels: Continuous slotted steel channel with inturned lips.

C. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.

D. Hanger Rods: As specified for Metal Pipe Hangers and Supports above.

E. Coatings: Manufacturer’s standard finish, unless otherwise noted.
2.5 THERMAL-HANGER SHIELD INSERTS

A. Insulation-Insert Material for Piping: ASTM C552, Type II cellular glass with 100-psig, ASTM C591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.

B. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

C. For Clevis Hangers: Insert and shield shall cover lower 180 degrees of pipe.

D. Insert Length: Extend 2-inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 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.

2.7 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.8 MISCELLANEOUS MATERIALS

A. Structural and Miscellaneous Steel: As specified in Division 23 Section “Basic Mechanical Materials and Methods.”

B. Grout: As specified in Division 23 Section “Basic Mechanical Materials and Methods.”

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT SCHEDULE OF APPLICATIONS

A. Comply with MSS SP-69 for pipe hanger and trapeze selections and applications that are not specified in this Section.

B. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment.

D. Use copper-plated pipe hangers and copper or stainless-steel attachments, or use nonmetallic coatings on attachments for electrolytic protection, where hangers are in direct contact with copper tubing.
E. Horizontal-Piping Hangers and Supports for individual, insulated pipe runs which are both 2½-inch diameter or larger and 100 feet or longer: Unless otherwise indicated, choose among the following types:

1. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes from single rod.
2. Exception: Piping whose normal operating temperature is less than 150°F (e.g., chilled water, condenser water) may be supported with static hangers specified in the next paragraph.

F. Horizontal-Piping Hangers and Supports for individual pipe runs less than 100 feet long and all piping 2-inch diameter or smaller, regardless of length: Unless otherwise indicated, choose among the following types:

1. Adjustable Steel Clevis Hangers (MSS Type 1).

G. Horizontal-Piping Hangers and Supports for individual uninsulated pipe runs of any size or length: Unless otherwise indicated, choose among the following types:

1. Adjustable Steel Clevis Hangers (MSS Type 1).

H. Vertical-Piping Hangers and Supports for individual, insulated pipe runs which are both 2½-inch diameter or larger and 20 feet or longer: Use spring hangers and supports. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports shall include the following types:

1. Horizontal (MSS Type 54): Mounted horizontally.
2. Vertical (MSS Type 55): Mounted vertically.
3. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

I. Vertical-Piping Hangers and Supports for individual pipe runs less than 20 feet long and all piping 2-inch diameter or smaller, regardless of length: Unless otherwise indicated, choose among the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8).
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): Where longer ends are required.

J. Vertical-Piping Hangers and Supports for individual uninsulated pipe runs of any size or length: Unless otherwise indicated, choose among the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8).
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): Where longer ends are required.

K. Hanger-Rod Attachments: Unless otherwise indicated, choose among the following types:

1. Steel Turnbuckles (MSS Type 13).
2. Steel Clevises (MSS Type 14).
3. Malleable-Iron Sockets (MSS Type 16).
4. Steel Weldless Eye Nuts (MSS Type 17).

L. Building Attachments: Unless otherwise indicated, choose among the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to concrete ceiling.
2. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
3. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams.
4. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
5. 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.
6. Side-Beam Brackets (MSS Type 34): For sides of steel beams.
7. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

3.2 HANGER AND SUPPORT MAXIMUM SPACING AND MINIMUM ROD SIZE

A. Install hangers and supports with the following maximum spacing and minimum rod sizes.

B. Flanged, Threaded, or Welded Steel Piping for any Liquid-service piping systems:

1. NPS ½: Maximum span, 5 feet; minimum rod size, 3/8-inch.
2. NPS ¾: Maximum span, 7 feet; minimum rod size, 3/8-inch.
3. NPS 1: Maximum span, 7 feet; minimum rod size, 3/8-inch.
4. NPS 1¼: Maximum span, 7 feet; minimum rod size, 3/8-inch.
5. NPS 1½: Maximum span, 9 feet; minimum rod size, 3/8-inch.
6. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8-inch.

C. Drawn-Temper Copper Piping for any liquid-service piping systems:

1. NPS ½: Maximum span, 4 feet; minimum rod size, 3/8-inch.
2. NPS ¾: Maximum span, 5 feet; minimum rod size, 3/8-inch.
3. NPS 1: Maximum span, 6 feet; minimum rod size, 3/8-inch.
4. NPS 1¼: Maximum span, 6 feet; minimum rod size, 3/8-inch.
5. NPS 1½: Maximum span, 8 feet; minimum rod size, 3/8-inch.
6. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8-inch.

D. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

E. Rod diameters may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

F. Hanger and support spacing for piping and tubing not listed above shall be according to MSS SP-69 and piping manufacturer’s written instructions.

3.3 HANGER AND SUPPORT INSTALLATION

A. 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.
B. 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.

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.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

F. Install hangers and supports to allow controlled thermal movement of piping systems.

G. Install lateral bracing with pipe hangers and supports to prevent swaying.

H. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

I. 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.

J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2½ 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.

K. Repair any building insulation or building fireproofing materials, whether new or existing, that are removed or scraped away in order to attach hangers and supports, so as to maintain an equivalent insulation or fire rating as existed without said hanger or support attachment.

L. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4-inchesthick 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.

3.4 PROTECTION OF INSULATED PIPING:

A. Attach clamps and spacers to piping.
   1. Use thermal-hanger shield insert with clamp sized to match OD of insert.

B. Do not exceed pipe stress limits according to ASME B31.9.

C. Clevis-type supports shall be sized for the outside diameter of the insulation including jacket. Install MSS SP-58, Type 40 protective metal shields. Shields shall span an arc of 180 degrees.

3.5 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.

3.6 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and/or 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.

3.7 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 1½-inches.

3.8 PAINTING

A. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

B. 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. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

C. 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.

END OF SECTION
SECTION 23 05 93 – TESTING, ADJUSTING, AND BALANCING

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 testing, adjusting, and balancing HVAC systems to produce design objectives, including the following:

1. Balancing airflow and water flow within distribution systems, including submains, branches, and terminals, to indicated quantities according to specified tolerances.
2. Adjusting total HVAC systems to provide indicated quantities.
4. Reporting results of the activities and procedures specified in this Section.

B. Related Sections include the following:

1. Testing and adjusting requirements unique to particular systems and equipment are included in the Sections that specify those systems and equipment.
2. Field quality-control testing to verify that workmanship quality for system and equipment installation is specified in system and equipment Sections.

1.3 DEFINITIONS

D. SMACNA: Sheet Metal and Air Conditioning Contractors’ National Association.

1.4 SUBMITTALS

A. Certified Testing, Adjusting, and Balancing Reports: Submit 2 copies of reports prepared, as specified in this Section, on approved forms certified by the testing, adjusting, and balancing Agent.

1.5 QUALITY ASSURANCE

A. Agent Qualifications: Engage a testing, adjusting, and balancing agent certified by either AABC or NEBB.
B. Certification of Testing, Adjusting, and Balancing Reports: Certify the testing, adjusting, and balancing field data reports.

D. Instrumentation Type, Quantity, and Accuracy: As described in AABC national standards or in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification" except where more stringent requirements are specified in this Section.

E. Instrumentation Calibration: Calibrate instruments at least every 6 months or more frequently if required by the instrument manufacturer.

1.6 PROJECT CONDITIONS

A. Full Owner Occupancy: The Owner will occupy the site and existing building during the entire testing, adjusting, and balancing period. Cooperate with the Owner during testing, adjusting, and balancing operations to minimize conflicts with the Owner's operations.

1.7 COORDINATION

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist testing, adjusting, and balancing activities.

B. Notice: Provide 7 days' advance notice for each test. Include scheduled test dates and times.

C. Perform testing, adjusting, and balancing after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Contract Documents to become familiar with project requirements.

B. Examine approved submittal data of HVAC systems and equipment.

C. Examine equipment performance data, including fan and pump curves.

D. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

E. Examine air-handling equipment to ensure clean filters have been installed.

F. Examine terminal units, such as variable-air-volume boxes and mixing boxes, to verify that they are accessible.
G. Report deficiencies discovered before and during performance of testing, adjusting, and balancing procedures.

3.2 PREPARATION

A. Before beginning testing, adjusting and balancing, verify the following:

1. Permanent electrical power wiring is complete.
2. Hydronic systems are filled, clean, and free of air.
3. Automatic temperature-control systems are operational.
4. Equipment and duct access doors are securely closed.
5. Balance and fire dampers are open.
6. Isolating and balancing valves are open and control valves are operational.
7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
8. Windows and doors can be closed so design conditions for system operations can be met.

3.3 TESTING AND BALANCING PROCEDURES

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC national standards or NEBB’s “Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems” except where more stringent requirements are specified in this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to the insulation Specifications for this Project.

C. Mark equipment settings with paint or other suitable, permanent identification material, including damper-control positions, valve indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

D. Set HVAC system airflow and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans: Plus or minus 5 percent.
2. Air Outlets and Inlets: Plus or minus 10 percent.
3. Heating-Water Flow Rate: Plus or minus 5 percent.
4. Cooling-Water Flow Rate: Plus or minus 5 percent.

E. For hydronic systems without field-adjustable balance valves (for example, systems that use automatic flow limiting valves): The work of this Section includes measuring and verifying the water flow rates at each terminal even though balance valve adjustment may not be applicable.

3.4 FINAL REPORT

A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in 3-ring binder, tabulated and divided into sections by tested and balanced systems.
B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer. Include a list of the instruments used for procedures, along with proof of calibration.

C. Final Report Contents: In addition to the certified field report data, include pump curves and fan curves.

D. General Report Data: In addition to the form titles and entries, include the following data in the final report, as applicable:

1. Title page.
2. Name and address of testing, adjusting, and balancing Agent.
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 testing, adjusting, and balancing Agent who certifies the report.
10. Summary of contents, including design versus final performance, notable characteristics of systems, and description of system operation sequence if it varies from the Contract Documents.
11. Nomenclature sheets for each item of equipment.
12. Data for terminal units, including manufacturer, type size, and fittings.
13. Notes to explain why certain final data in the body of reports vary from design values.
14. Test conditions for fans and pump performance forms.

E. System Diagrams: Include schematic layouts of air and hydronic distribution systems with a keyed identification system for each device.

F. Blower Coil Unit Test Reports.

G. Apparatus-Coil Test Reports: For all air handling unit coils.

H. Fan Reports: For all supply, return, and exhaust fans.

I. Duct Traverse Reports.

J. Air-Terminal-Device Reports: For each terminal unit, air inlet, and air outlet.

K. System-Coil Reports: For all reheat coils and water coils of terminal units.

L. Instrument Calibration Reports: For instrument calibration, include instrument type and make, serial number, application, dates of use, and dates of calibration.

END OF SECTION
SECTION 23 07 00 - MECHANICAL INSULATION

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 mechanical insulation for ductwork, equipment, piping, boiler breechings and other installations, including the following:

1. Insulation Materials:
   a. Flexible elastomeric.
   b. Mineral fiber.

2. Insulating cements.
3. Adhesives.
5. Sealants.
6. Factory-applied jackets.
7. Field-applied jackets.
8. Tapes.

1.3 DEFINITIONS

A. ASJ: All-service jacket.
B. FSK: Foil, scrim, kraft paper.
C. Thermal Resistivity: “R-values” represent the reciprocal of thermal conductivity (k-value). Thermal conductivity is the rate of heat flow through a homogenous material exactly 1-inch thick. Thermal resistivities are expressed by the temperature difference in degrees F between two exposed faces required to cause one BTU to flow through one square foot of material, in one hour, at a given mean temperature.
D. Refer to Division 23 Section “Basic Mechanical Materials and Methods” for definitions of finished, interior, exterior, exposed, and concealed locations.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated, identify thermal conductivity, thickness, and jackets (both factory and field applied, if any).
B. Shop Drawings: Show details for the following:
   1. Application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
   2. Insulation application at pipe expansion joints for each type of insulation.
3. Insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
4. Removable insulation at piping specialties, equipment connections, and access panels.
5. Application of field-applied jackets.
6. Application at linkages of control devices.
7. Field application for each equipment type.

C. Installer Certificates: Signed by Contractor certifying that installers comply with requirements.

D. 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.

E. Field quality-control inspection 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 flame-spread index of 25 or less, and smoke-developed index of 50 or less, as determined by testing identical products per ASTM E84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

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 23 Section “Hangers and Supports.”

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

1.8 SCHEDULING

A. Schedule insulation application after pressure testing systems. Insulation application may begin on segments that have satisfactory test results.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:

1. Flexible Elastomeric Insulation:
   a. Aeroflex USA Inc.; Aerocel.
   b. Armacell LLC; AP Armawflex.
   c. K-Flex USA; Insul-Lock® Seam-Seal.
   d. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.

2. Mineral Fiber Duct Insulation:
   a. CertainTeed Corp.
   b. Johns Manville.
   c. Knauf Insulation.
   d. Manson Insulation Inc.
   e. Owens Corning.

3. Mineral-Fiber, Preformed Pipe Insulation:
   b. Knauf Insulation.
   c. Manson Insulation Inc.
   d. Owens Corning.

2.2 INSULATION MATERIALS

A. Refer to Schedule in Part 3 for requirements about 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 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. Adhesives shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

G. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C534, Type I for tubular materials and Type II for sheet materials.

   1. Thermal Conductivity: 0.28 average maximum at 75°F mean temperature.
H. 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 jacket.

1. Thermal Conductivity: 0.26 average maximum at 75°F mean temperature.
2. Density: 1.5 pcf (24-kg/cu. m) minimum.
3. Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.

I. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C612, Type IA or Type IB.

1. Thermal Conductivity: 0.26 average maximum at 75°F mean temperature.
2. Density: 2.0 pcf (32-kg/cu. m) minimum.
3. Jacket (Ducts): Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.
4. Jacket (Equipment): White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.

J. Mineral-Fiber, Preformed Pipe Insulation: Type I, 850°F mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C547, Type I, Grade A, with factory-applied jacket.

1. Thermal Conductivity: 0.26 average maximum at 75°F mean temperature.
3. Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

K. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material complying with ASTM C1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C612, Type IB.

1. Thermal Conductivity: 0.29 average maximum at 100°F mean temperature.
2. Density: 2.5 pcf (40-kg/cu. m) minimum.
3. Jacket: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
4. Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

2.3 INSULATING CEMENTS


B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C196.

C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C449/C 449M.

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
2.5 SEALANTS

A. Joint Sealants:
   1. Materials shall be compatible with insulation materials, jackets, and substrates.
   2. Permanently flexible, elastomeric sealant.
   3. Service Temperature Range: Minus 100 to plus 300°F.

B. FSK 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°F.

C. ASJ Flashing Sealants, and Vinyl and PVC 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°F.

2.6 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C921, 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. Adhesive: Compatible with PVC, as recommended by jacket material manufacturer.
   3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
4. 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.
5. Factory-fabricated tank heads and tank side panels.

2.7 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136 and UL listed.

1. Width: 3-inches.
2. Thickness: 11.5 mils.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136 and UL listed.

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.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.

1. Width: 2-inches.
2. Thickness: 6 mils.
3. Adhesion: 64 ounces force/inch in width.
4. Elongation: 500 percent.
5. Tensile Strength: 18 lbf/inch in width.

D. Bands:

1. Stainless Steel: ASTM A167 or ASTM A240, Type 304; 0.015-inch thick, ½-inch wide with wing or closed seal.
2. Aluminum: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020-inch thick, ½-inch wide with wing or closed seal.

E. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated with integral 1½-inch galvanized carbon-steel washer.
3. 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. Baseplate shall be perforated, galvanized carbon-steel sheet, 0.030-inch thick by 2-inches square. Spindle shall be copper, aluminum, or stainless steel, fully annealed, 0.106-inch diameter shank, length to suit depth of insulation indicated. Adhesive shall be as recommended by hanger manufacturer; with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

4. Self-Sticking-Base Insulation Hangers: Adhesive-backed base with a peel-off protective cover; and 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. Baseplate shall be galvanized carbon-steel sheet, 0.030-inch thick by 2-inches square. Spindle shall be copper, aluminum, or stainless steel, fully annealed, 0.106-inch diameter shank, length to suit depth of insulation indicated.

5. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch thick, aluminum or stainless-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1½-inches in diameter. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

F. Staples: Outward-clinching insulation staples, nominal ¾-inch-wide, stainless steel or Monel.

G. Wire: 0.062-inch soft-annealed, stainless steel.

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.

B. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 COMMON INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.
B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and 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 application and finishing.

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. 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. 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.

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 1½-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.
4. Apply vapor-barrier mastic over staples.
5. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
6. Apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.
M. Cut insulation in a manner to avoid compressing insulation more than 75 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 similar to butt joints.

P. At the following locations, omit jacket and provide a separate cutaway removable segment of insulation clearly labeled “Access.” For below-ambient services, provide a design that allows access but maintains vapor barrier.

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
5. Handholes.
6. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

B. Insulation Installation at Fire-Rated Wall and Partition Penetrations:

1. Install pipe insulation continuously through pipe penetrations of fire-rated walls and partitions.
2. Install duct insulation continuously through duct penetrations of fire-rated walls and partitions, for cases where no fire or smoke damper is required.
3. Terminate duct insulation at fire or smoke damper sleeves for cases where fire or smoke dampers are used, but overlap duct insulation at least 2-inches.
4. Firestopping and fire-resistive joint sealers are specified in Division 07 Section “Penetration Firestopping.”

C. Insulation Installation at Floor Penetrations:

1. Duct: Install insulation continuously through floor penetrations that are not fire rated. 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. Pipe: Install insulation continuously through floor penetrations.
3. Seal penetrations through fire-rated assemblies according to Division 07 Section “Penetration Firestopping.”
3.5 DUCT INSULATION INSTALLATION

A. Secure all insulation on ducts and plenums with insulation pins. 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:

1. On duct sides with dimensions 18-inches and smaller, pins may be omitted.
2. On duct sides with dimensions 18-inches and larger, place pins along longitudinal centerline of duct. Space 3-inches maximum from insulation end joints, and 16-inches o.c.
3. On duct sides with dimensions larger than 36-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.
4. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
5. Do not overcompress insulation during installation.
6. If using blanket insulation, impale insulation over pins and attach speed washers.
7. 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.

B. Install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2-inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with ½-inch outward-clinching staples, 1-inch o.c. Complete the vapor barrier by applying FSK tape specified in Part 2, or vapor-barrier mastic and sealant, at all joints, seams, and protrusions.

1. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
2. Install vapor stops for ductwork and plenums operating below 50°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 2 times the insulation thickness but not less than 3-inches.

C. If using blanket insulation, 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.

D. Unless factory-insulated, install duct insulation continuously and unbroken over duct-mounted accessories such as fans, coils, terminal units, etc.

E. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. If using board insulation, groove and score insulation to fit as closely as possible to outside and inside radius of elbows.

F. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.

G. 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.
3.6 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

A. Where required, secure blanket or board insulation to equipment, tanks and vessels with adhesive and anchor pins and speed washers.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of tank and vessel surfaces.
2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
3. Protect exposed corners with secured corner angles.
4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels. Do not weld anchor pins to ASME-labeled pressure vessels. Select insulation hangers and adhesive that are compatible with service temperature and with substrate. On tanks and vessels, maximum anchor-pin spacing is 3-inches from insulation end joints, and 16-inches o.c. in both directions. Do not overcompress insulation during installation. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels. Impale insulation over anchor pins and attach speed washers. 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.
5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6-inches from each end. Install wire or cable between two circumferential girdles 12-inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48-inches o.c. Use this network for securing insulation with tie wire or bands.
7. Stagger joints between insulation layers at least 3-inches.
8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.

1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
2. Seal longitudinal seams and end joints.

3.7 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 Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with tape or bands and tighten without deforming insulation materials. If furnished in half sections, orient longitudinal joints at 3 and 9 o’clock positions on the pipe.
2. All insulation shall be tightly butted and free of voids and gaps at all joints.
3. Seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
4. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6-inches o.c.
5. For insulation with factory-applied jackets on below ambient services, 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. Vapor barrier must be continuous.

C. 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, not to exceed 1½-inch thickness.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer’s recommended adhesive, overlap seams at least 1-inch, and seal joints with flashing sealant.

D. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer’s written instructions.
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.
3. Cut sectional pipe insulation to fit. 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.

E. Insulation Installation on Valves, Strainers, Unions, and Specials:

1. 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.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation over valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
4. 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.

5. Insulate 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.

6. 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.

7. For services not specified to receive a field-applied jacket except for flexible elastomeric, 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.

8. Stencil or label the outside insulation jacket of each union with the word “UNION.” Match size and color of pipe labels.

F. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, 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.

G. 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.
H. Special Requirements for Flexible Elastomeric Insulation Installation: Seal all transverse seams, longitudinal seams, end joints, and section joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.8 FIELD-APPLIED JACKET INSTALLATION

A. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

3.9 FINISHES

A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

B. Duct, Equipment, and Pipe Insulation with ASJ or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.

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.

C. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

D. Color: Final color as selected by Owner. Vary first and second coats to allow visual inspection of the completed Work.

E. Do not field paint aluminum or stainless-steel jackets.

3.10 DUCT AND PLENUM INSULATION SCHEDULE

A. Plenums and Ducts Requiring Insulation:

1. Indoor supply air ducts.
2. Elsewhere as noted on Drawings.

B. Items Not Insulated:

1. Metal ducts with internal duct liner, unless noted to be insulated.
2. Factory-insulated flexible ducts.
3. Factory-insulated plenums and casings.
4. Flexible connectors.
5. Vibration-control devices.
6. Factory-insulated access panels and doors.

3.11 DUCT AND PLENUM INSULATION DETAILS

A. Where insulation is required via the Duct and Plenum Insulation Schedule above, insulation for indoor concealed rectangular, round ducts and plenums shall be Mineral-
Fiber blanket, thick enough to achieve an installed R-value of 3.5 but not less than 1½-inches thick; and 1.5-lb/cu. ft. nominal density.

B. Where insulation is required via the Duct and Plenum Insulation Schedule above, insulation for indoor exposed round ducts and plenums shall be Mineral-Fiber blanket, thick enough to achieve an installed R-value of 3.5 but not less than 1½-inches thick; and 1.5-lb/cu. ft. nominal density.

C. Where insulation is required via the Duct and Plenum Insulation Schedule above, insulation for indoor exposed rectangular ducts and plenums shall be Mineral-Fiber board, thick enough to achieve an installed R-value of 3.5 but not less than 1½-inches thick; and 1.5-lb/cu. ft. nominal density.

3.12 PIPING INSULATION SCHEDULE, GENERAL

A. Hot Surfaces: For piping services denoted as 140°F or greater, all piping surfaces including but not limited to pipe, flanges, fittings, valves of every kind, strainers, unions, and other appurtenances shall be insulated to avoid potential for personnel injury via contact with hot surface.

B. Cold Surfaces: For piping surfaces operating below surrounding ambient temperature, all piping surfaces including but not limited to pipe, flanges, fittings, valves of every kind, strainers, unions, and other appurtenances shall be insulated and shall include uninterrupted vapor barrier to avoid potential condensation.

3.13 PIPE INSULATION SCHEDULE, INDOORS

A. Condensate and Equipment Drain Water below 60°F Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Condensate and Equipment Drain Water below 60°F:

1. NPS 6 and Smaller: Insulation shall be either of the following:
   a. Flexible Elastomeric: ¾-inch thick.
   b. Mineral-Fiber Pipe Insulation, Type I: ½-inch thick.

2. NPS 8 and Larger: Insulation shall be Mineral-Fiber Pipe Insulation, Type I, ½-inch thick.

B. Chilled Water and Brine, above 40°F:

1. NPS 1¼ and Smaller: Insulation shall be any of the following:
   b. Mineral-Fiber, Preformed Pipe, Type I: 1-inch thick.

2. NPS 1½ and Larger: Insulation shall be any of the following:
   a. Flexible Elastomeric Type II: 1½-inches thick.
   b. Mineral-Fiber, Preformed Pipe, Type I: 1½-inches thick.
C. Heating-Hot-Water Supply and Return, 200°F and below:

1. NPS 1¼ and Smaller: Insulation shall be Mineral-Fiber, Preformed Pipe, Type I, 1½-inches thick.
2. NPS 1½ and Larger: Insulation shall be Mineral-Fiber, Preformed Pipe, Type I, 2-inches thick.

D. Hot Service Drains, Blowdowns, and Vents: For all pipe sizes, insulation shall be Mineral-Fiber, Preformed Pipe, Type I, 1-inch thick.

END OF SECTION
SECTION 23 21 13 – HYDRONIC 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. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:
   1. Hot-water heating piping.
   2. Chilled-water piping.
   3. Condensate-drain piping.

1.3 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:
   1. Hot-Water Heating Piping: 150 psig at 200°F.
   2. Chilled-Water Piping: 150 psig at 200°F.
   3. Condensate-Drain Piping: 150°F.
   4. Air-Vent Piping: 200°F.

1.4 SUBMITTALS

A. Product Data: For each type of the following:
   1. Valves. Include flow and pressure drop curves based on manufacturer’s testing for calibrated-orifice balancing valves and automatic flow-control valves.
   2. Air control devices.
   3. Hydronic specialties.

B. Welding certificates.

C. Qualification Data: For Installer.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, “Structural Welding Code - Steel.”
B. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
   2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.


D. Comply with NFPA 70 – National Electrical Code. Do not route piping directly above electric panelboards and switchboards, or other prohibited locations.

1.6 COORDINATION

A. Coordinate layout and installation of hydronic piping and suspension system components with other construction, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

B. Coordinate pipe fitting pressure classes with products specified in related Sections.

C. Coordinate installation of pipe sleeves for penetrations through walls and floor assemblies. Coordinate with requirements for firestopping specified in Division 07 Section “Penetration Firestopping” for fire and smoke wall and floor assemblies.

1.7 EXTRA MATERIALS

A. Differential Pressure Meter: For each type of balancing valve and automatic flow control valve, include flowmeter, probes, hoses, flow charts, and carrying case.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   1. Manual Balancing Valves:
      a. Armstrong Pumps, Inc.
      b. “Circuit Setter” by Bell & Gossett; a Xylem Brand.
      c. Nexus Valve.
      d. Nibco Inc.
      e. Taco.
      f. Tour & Andersson.

   2. Automatic Flow-Control Valves:
      a. Flow Design Inc.
      b. Griswold Controls.
      c. Nexus Valve.
      d. Pro-Hydronic Specialties, LLC.

   3. Manual Air Vents:
4. Strainers:
   b. Eaton Filtration.
   c. Hoffman Specialty ITT; Fluid Handling Div.
   d. Metraflex Co.
   e. Nibco Inc.
   f. Spirax Sarco.
   g. Watts Regulator Co.

2.2 PIPING MATERIALS

A. General: Refer to Part 3 “Piping Applications” Article for applications of pipe and fitting materials, including a schedule of which types of piping to use in which application.

2.3 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B88, Type L (ASTM B88M, Type B).
B. Wrought-Copper Fittings: ASME B16.22.
C. Wrought-Copper Unions: ASME B16.22.

2.4 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A53/A53M, black steel with plain ends; Type E (Electric-resistance welded), Grade B, Schedule 40; unless otherwise indicated in Part 3 “Piping Applications” Article.
B. Steel Pipe Nipples: ASTM A733, made of ASTM A53/A53M black steel, Grade B, Schedule 40; unless otherwise indicated in Part 3 “Piping Applications” Article.
C. Malleable-Iron Unions: ASME B16.39; Class 150, 250, or 300 as indicated in Part 3 “Piping Applications” Article.
D. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Class 125 or 250 as indicated in Part 3 “Piping Applications” Article; raised ground face, and bolt holes spot faced.
E. Wrought-Steel Fittings: ASTM A234/A234M, wall thickness to match adjoining pipe. All elbows shall be long-radius type.
F. Wrought Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of Material Group 1.1, butt-weld end connections, and raised facings.
2.5 SPECIALTIES

A. Refer to Division 23 Section “Basic Mechanical Materials and Methods” for joining materials, transition fittings, and dielectric fittings. Those requirements apply to the work of this Section as if fully reproduced herein.

2.6 GENERAL-PURPOSE VALVES

A. Refer to Division 23 Section “Valves” for Ball and Butterfly Valves, whose requirements apply to the work of this Section as if fully reproduced herein.

B. Refer to Part 3 “Valve Applications” Article elsewhere within this Section for applications of each type of valve and service.

2.7 SPECIALTY VALVES

A. Calibrated-Orifice Balancing Valves:

1. Body (Size 2-inch NPS and smaller): Bronze or DZR-brass body; ball- or plug-type with calibrated orifice or venturi.
2. Body (Size 2½-inch NPS and larger): Cast-iron or steel body; ball, plug, or globe pattern with calibrated orifice or venturi.
3. Ball: Brass or stainless steel.
4. Plug: Resin.
5. Seat: PTFE.
7. Disc: Glass and carbon-filled PTFE.
8. End Connections (Size 2-inch NPS and smaller): Threaded or socket.
9. End Connections (Size 2½-inch NPS and larger): Flanged or grooved.
11. Handle Style: Lever, with memory stop to retain set position.
12. Accessories: Integral pointer and calibrated scale to register degree of valve opening.
14. Maximum Operating Temperature: 250ºF.

B. Automatic Flow-Control Valves:

1. Body: DZR-brass or ferrous metal.
2. Piston and Spring Assembly: Bronze or Stainless steel; tamper proof, self cleaning, and removable.
3. Combination Assemblies: Include bronze or brass-alloy ball valve.
4. Identification Tag: Marked with zone identification, valve number, and flow rate.
5. Size: Same as pipe in which installed.
6. Performance: Maintain constant flow, plus or minus 5 percent over system pressure fluctuations.
8. Maximum Operating Temperature: 250°F.

C. Pre-packaged Hydronic Coil Connection Kits: Pre-packaged hydronic coil connection kits, composed of multiple pre-assembled components such as valves, fittings, balancing devices, strainers, flexible pipe connectors, and so forth, are acceptable at Contractor's Option provided that each individual component in the kit is in complete and strict accordance with the respective individual component specification found throughout
Division 23; and provided that the arrangement of the kit equals the arrangement of coil trim components as detailed on the Drawings.

2.8 AIR CONTROL DEVICES

A. Manual Air Vents:

1. Body: Bronze.
2. Internal Parts: Nonferrous.
4. Inlet Connection: NPS ½.
7. Maximum Operating Temperature: 225ºF.

2.9 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers, 2-inch and Smaller:

1. Body (for use in Copper piping): ASTM B584 C84400 or ASTM B-62 C83600 bronze body, with threaded bronze cover and brass drain plug.
4. Strainer Screen: 20-mesh, Type 304 stainless steel.
5. CWP Rating: 200 psig at 150ºF.
6. SWP Rating: 150 psig at 350ºF.

B. Y-Pattern Strainers, 2½-inch and Larger:

1. Body: ASTM A126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Flanged ends.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 175 psig at 150ºF.
5. SWP Rating: 125 psig at 350ºF.

C. Refer to Division 23 Section “Basic Mechanical Materials and Methods” for Flexible Pipe Connectors, whose requirements apply to the work of this Section as if fully reproduced herein.

PART 3 - EXECUTION

3.1 PIPING SCHEDULE OF APPLICATIONS

A. Hot-water heating piping, Chilled-water piping, aboveground, NPS 2 and smaller, shall be Type L, draw-temper copper tubing, wrought-copper fittings, and soldered joints.

B. Hot-water heating piping, Chilled-water piping, aboveground, NPS 2½ and larger, shall be Standard Weight steel pipe; wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints. All elbows shall be long-radius type.
C. Cooling Coil Condensate-Drain Piping: Type L, drawn-temper copper tubing, wrought-
copper fittings, and soldered joints.

D. Hydronic heating system drains (blowdown, overflow, etc.): Use same materials and
joining methods as for hot-water heating piping described above.

E. Chilled-water system drains (blowdown, overflow, etc.): Use same materials and joining
methods as for chilled-water piping described above; or use Schedule 40 PVC plastic
pipe and fittings and solvent-cemented joints.

F. Air-Vent Piping: Same materials and joining methods as for piping specified for the
service in which air vent is installed.

3.2 VALVE APPLICATIONS

A. Install valves where indicated on Drawings and where indicated in Division 23 Section
“Valves.”

B. Install safety valves as required by ASME Boiler and Pressure Vessel Code. Install drip-
pan elbow on safety-valve outlet and pipe without valves to the outdoors; and pipe drain
to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and
Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

C. Install specialty valves where indicated on Drawings.

D. Install drain valves at all low points, and manual air vents at all high points, in mains,
risers, branch lines and elsewhere as required for system drainage.

E. Any valve that represents a termination or the end of a run (e.g., blowdown or drain
valve, hose-end valve, etc.) shall be fitted with a permanent but removable cap, plug, or
blind flange matching the valve construction, to minimize risk in the event the valve is
accidentally opened under pressure.

3.3 PIPING INSTALLATIONS

A. General: General piping installation is specified in Division 23 Section “Basic Mechanical
Materials and Methods,” whose requirements apply to the work of this Section as if fully
repeated herein.

B. Install drains, consisting of a tee fitting, NPS ¾ ball valve, and short NPS ¾ threaded
nipple with cap, at low points in piping system mains and elsewhere as required for
system drainage.

C. In closed systems, install horizontal piping at a uniform grade of 0.2 percent upward in
direction of flow. In open systems (i.e., condenser water).

D. For cooling coil condensate-drain piping, install horizontal piping at a uniform grade of 1.0
percent downward in the direction of flow.

E. Bull-head tees prohibited: Do not use tee fittings in such a way that the flow through the
branch leg equals the sum of the flows through two main legs.

F. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
G. Install branch connections to mains using 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.

H. Changes of direction, branches, tees, etc. shall be accomplished with the appropriate factory or foundry fitting meeting the requirements of these specifications. Mechanically-formed extruded tee outlets or field-fabricated tee branches and/or elbows are not acceptable.

I. All elbows shall be long-radius type.

J. Install valves according to Division 23 Section “Valves.”

K. Install unions in piping NPS 2 and smaller, at final connections of equipment and elsewhere as indicated.

L. Install flanges in piping NPS 2½ and larger, at final connections of equipment and elsewhere as indicated.

M. Install strainers on inlet side of each control valve, pressure-reducing valve, in-line pump, and elsewhere as indicated. Install NPS ¾ nipple and ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blow-off connection for strainers smaller than NPS 2.

N. Install and anchor piping to allow for proper length and direction of expansion and contraction.

O. Connect risers and branch connections to mains with at least five pipe fittings, including tee in main.

P. Connect risers and branch connections to terminal units with at least four pipe fittings, including tee in riser.

Q. Connect mains and branch connections to terminal units with at least four pipe fittings, including tee in main.

R. Identify piping as specified in Division 23 Section “Basic Mechanical Materials and Methods.”

S. Hang, support, and anchor all piping as specified in Division 23 Section “Hangers and Supports.”

3.4 PIPE JOINT CONSTRUCTION

A. Refer to Division 23 Section “Basic Mechanical Materials and Methods” for joint construction requirements for soldered joints in copper tubing; threaded, welded, and flanged joints in steel piping; and solvent-welded joints for PVC and CPVC piping.


1. Apply one coat of self-priming, rust-inhibitor paint around the entire circumference of each welded pipe joint; regardless of whether or not the piping
is specified to be painted. Paint may be brush-applied, roller-applied, or spray-applied at contractor’s option.

3.5 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.

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, but outside the service area. For example, control valve shall be as close to hydronic coil as practical, but not within the coil pull space and/or access door swing space.

C. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to Division 23 Section “Meters and Gages.”

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. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
   3. 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.
   4. 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. Do not pressure test with air.
   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. 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 “SE” value in Appendix A in ASME B31.9, “Building Services Piping.”
   4. Minimum duration of test shall be four (4) hours. During the final hour of the hydrostatic test, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
   5. Prepare written report of testing.
C. Perform the following before operating the system:

1. Open manual valves fully.
2. Inspect air vents at high points of system and determine if all are installed and bleed air completely (manual type).
3. Set temperature controls so all coils are calling for full flow.
4. Verify lubrication of motors and bearings.

3.8 CLEANING AND ADJUSTING

A. Flush hydronic piping systems with clean water. Remove and clean or replace strainer screens. After cleaning and flushing hydronic piping systems, but before balancing, remove disposable fine-mesh strainers in pump suction diffusers.

END OF SECTION
SECTION 23 31 13 – 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. This Section includes metal ducts and plenums for supply, return, outside, and exhaust air-distribution systems in pressure classes from minus 2- to plus 10-inch wg. Metal ducts include the following:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round ducts and fittings.
4. Sealants and gaskets.
5. Hangers and supports.

1.3 PERFORMANCE REQUIREMENTS

A. Duct system design, as indicated, has been used to select size and type of air-moving and distribution equipment and other air system components. Changes to layout or configuration of duct system must be specifically approved in writing by the design professional. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.

B. Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA HVAC Duct Construction Standards – Metal and Flexible and performance requirements and design criteria indicated in Part 3 of this Section.

C. Structural Performance: Duct hangers and supports shall withstand the effects of gravity within limits and under conditions described in SMACNA HVAC Duct Construction Standards – Metal and Flexible and SMACNA’s.

D. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2010.

1.4 SUBMITTALS

A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.
3. Manufactured ductwork and duct fittings.
4. Sheet metal thicknesses.
5. Joint and seam construction and sealing.
6. Reinforcement details and spacing.
7. Materials, fabrication, assembly, and spacing of hangers and supports.
B. Shop Drawings: CAD-generated and drawn to 1/4-inch equals 1 foot scale. Show fabrication and installation details for metal ducts as follows:

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 and pressure classes.
4. Elevations of top and bottom 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. Duct accessories, including access doors and panels.
12. Hangers and supports, including methods for duct and building attachment and vibration isolation.

C. Coordination Drawings: Comply with Division 23 Section “Basic Mechanical Requirements” for Coordination Drawings. Include reflected ceiling plans, 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. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components and ceiling suspension assembly members.
3. Other systems installed in same space as ducts.
4. Structural members to which duct will be attached.
5. Size and location of initial access modules for acoustical tile.
6. Ceiling- and wall-mounting access doors and panels required to provide access to dampers and other operating devices.
7. Penetrations of smoke barriers and fire-rated construction.
8. Ceiling-mounting items and/or items penetrating finished ceiling, including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

D. Welding certificates: Copies of certificates indicating welding procedures and personnel, to comply with requirements in “Quality Assurance” below.

E. Field quality-control test reports: Indicate and interpret test results for compliance with performance requirements.

F. Record Drawings: Indicate actual routing, fitting details, reinforcement, support, and installed accessories and devices.

1.5 QUALITY ASSURANCE

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

B. NFPA Compliance: Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - “Systems and Equipment” and Section 7 – “Construction and System Start-Up."

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 – "HVAC System Construction and Insulation."

1.6 REFERENCES


1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver sealant and firestopping materials to site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.

B. Store and handle sealant and firestopping materials according to manufacturer's written recommendations.

C. Deliver and store stainless-steel sheets with mill-applied adhesive protective paper maintained through fabrication and installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

2.2 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA 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. Sheet Gage: SMACNA standards notwithstanding, no material thinner than 26-gage is permitted for spiral-seam round duct, and no material thinner than 24-gage is permitted for all other ducts.

C. Galvanized Sheet Steel: Comply with ASTM A653 / A653M.
1. Galvanized Coating Designation: G60 or G90.

D. Reinforcement Shapes and Plates: ASTM A36 / A36M, steel plates, shapes, and bars; black and galvanized.

E. Tie Rods: Comply with Articles 2.5 through 2.9, including all accompanying Tables and Figures, of the SMANCA HVAC Duct Construction Standards.

2.3 SEALANT MATERIALS

A. Two-Part Sealing System: Woven-fiber tape impregnated with gypsum mineral compound and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.

B. One-Part Sealing System: Flexible, adhesive sealant, fiber-reinforced, resistant to UV light when cured, UL 723 listed, and complying with NFPA requirements for Class 1 ducts.

C. Water-Based Seam Sealant: Flexible, adhesive sealant, resistant to UV light when cured, UL 723 listed, and complying with NFPA requirements for Class 1 ducts.

D. Formed-on Duct Connectors: Flange shop roll-formed onto edge of ductwork, with corner closures, cleats and gaskets for seal; TDC or TDF constructed per SMACNA T-25a or T-25b.

1. Flanged Joint Mastic: One-part, acid-curing, silicone, elastomeric joint sealant complying with ASTM C920, Type S, Grade NS, Class 25, Use O.
2. Flange Gaskets: Butyl rubber or EPDM polymer with polyisobutylene plasticizer.

2.4 RECTANGULAR DUCT FABRICATION

A. General: Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA HVAC Duct Construction Standards – Metal and Flexible. Comply with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, deflection limits, and joint types and intervals, except where more stringent requirements are specified herein.

B. All sheet metal shall be a minimum of 24-gage thickness in any case. Use 24-gage sheet metal where SMACNA allows thinner material.

C. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure classification.

D. Materials: Free from visual imperfections such as pitting, seam marks, roller marks, stains, and discolorations.

E. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359-inch thick or less, with more than 10 sq. ft. of unbraced panel area, unless ducts are lined.

F. Pressure Classification: See Schedule in Part 3 of this Section.

G. Seal Classification: See Schedule in Part 3 of this Section.
H. Longitudinal Seams: Pittsburgh lock constructed per Type L-1 of SMACNA Figure 2-2 shall be used on all longitudinal seams. See “Seam and Joint Sealing” in Part 3 of this Section for further requirements.

I. Duct sizes shown on plans are actual sheet metal sizes and have been sized to account for the thickness of internal duct liner, if any.

J. All square-throat elbows of angle greater than 45° shall include single-thickness turning vanes.

K. Divided flow branches shall be Type 1 or Type 2 per SMACNA Figure 4-5. Type 3 divided flow branches are permitted only where expressly shown. Seek Engineer’s approval of Type 3 where space and/or layout clearances prohibit Type 1 or Type 2.

L. Branch connections shall be per SMACNA Figure 4-6, except that straight taps are not permitted on any ducts 2-inch pressure class or above. Straight-tap “spin-in” fittings are permitted on 1/2-inch and 1-inch pressure class ductwork only.

M. Offsets and transitions shall be per SMACNA Figure 4-7, except that offset Type 2 (mitered) is limited to an angle of 45°.

N. Fittings at obstructions shall be per SMACNA Figure 4-8, except that Figure D is not permitted. Use Figure 4-8.B in lieu of Figure 4-8.D. Seek Engineer’s approval of Figure 4-8.D where space and/or layout clearances prohibit use of Figure 4-8.B.

2.5 ROUND DUCT AND FITTING FABRICATION

A. Diameter as applied to flat-oval ducts in this Section is the diameter of a round duct with a circumference equal to the perimeter of a given size of flat-oval duct.

B. Round, Spiral Lock-Seam Ducts: Fabricate supply ducts of galvanized steel according to SMACNA HVAC Duct Construction Standards – Metal and Flexible except that 26-gage is the thinnest material acceptable. Longitudinal-seam round ducts (“stovepipe”) of a minimum 24-gage thickness, will be permitted on 1/2-inch and 1-inch pressure classifications only.

C. 90-Degree Tees and Laterals and Conical Tees: Fabricate to comply with SMACNA HVAC Duct Construction Standards – Metal and Flexible, with metal thicknesses specified for longitudinal-seam straight ducts.

D. Diverging-Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.

E. Fabricate elbows using die-formed, gored, pleated, or mitered construction. Bend radius of die-formed, gored, and pleated elbows shall be 1½ times duct diameter. Unless elbow construction type is indicated, fabricate elbows as follows:

1. Mitered-Elbow Radius and Number of Pieces: Welded construction complying with SMACNA HVAC Duct Construction Standards – Metal and Flexible unless otherwise indicated.

2. 90-Degree, 2-Piece, Mitered Elbows: Use only if approved by the Engineer where space restrictions do not permit using radius elbows. Fabricate with single-thickness turning vanes.
3. Round Elbows 8 Inches and Less in Diameter: Fabricate die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.

4. Round Elbows 9 through 14 Inches in Diameter: Fabricate gored or pleated elbows for 30, 45, 60, and 90 degrees unless space restrictions require mitered elbows. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.

5. Round Elbows Larger Than 14 Inches in Diameter: Fabricate gored elbows unless space restrictions require mitered elbows.

2.6 HANGERS AND SUPPORTS

A. General: Support all ductwork in accordance with Chapter 5 of SMACNA HVAC Duct Construction Standards – Metal and Flexible except where more stringent requirements are specified herein.

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches (100 mm) thick.

2. Exception: Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.

C. Hanger Materials: Galvanized sheet steel or threaded steel rod.


2. Strap and Rod Sizes: Comply with SMACNA HVAC Duct Construction Standards – Metal and Flexible for steel sheet width and thickness and for steel rod diameters.

3. Galvanized-steel straps attached to aluminum ducts shall have contact surfaces painted with zinc-chromate primer.

D. All supporting material surfaces in direct contact with supported ductwork (or flexible duct, or duct insulation, as applicable) shall be designed to maintain a minimum of one-inch in contact width along full length of contact.

E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

F. Trapeze and Riser Supports: Steel shapes complying with ASTM A36.


2.7 SHOP PRIME PAINT

A. All galvanized steel ductwork that will be installed exposed to view in finished spaces shall be shop-primed to accept field paint.

B. Primer for galvanized steel ducts shall be galvanized metal primer with total dry film thickness of 1.2 mils; such as Moore #155 or equal. Coordinate brand and selection with the party responsible for performance of Division 09 Painting Sections.
PART 3 - EXECUTION

3.1 DUCT PRESSURE CLASS SCHEDULE

A. Static-Pressure Classes: Unless otherwise indicated, construct ducts according to the following:

2. Variable-volume Supply Ducts upstream of VAV boxes: 3-inch wg.
4. Return Ducts: 2-inch wg, positive or negative pressure as applicable.
5. Exhaust Ducts: 2-inch wg, positive or negative pressure as applicable.

3.2 DUCT MATERIAL SCHEDULE

A. All ducts shall be galvanized steel, unless indicated otherwise.

3.3 DUCT INSTALLATION

A. Construct and install ducts according to SMACNA HVAC Duct Construction Standards – Metal and Flexible unless otherwise indicated.

B. Install round ducts in lengths not less than 12 feet unless interrupted by fittings.

C. Install ducts with fewest possible joints.

D. Install fabricated fittings for changes in directions, size, and shape and for connections.

E. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12-inches, with a minimum of 3 screws in each coupling.

F. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.

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

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

I. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.

J. Install duct accessories as required by Division 23 Section “Duct Accessories.”

K. Coordinate layout with ceiling, lighting layouts, and similar finished work.

L. Drawings are diagrammatic in nature. Not necessarily all fittings and offsets are shown. Provide all required fittings and offsets as required by field conditions and coordination with the work of other trades, whether specifically shown or not, for a complete and functional installation.

M. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.
N. Electrical Equipment Spaces: Route ducts to avoid passing through transformer vaults and electrical equipment spaces and enclosures.

O. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1½ inches.

P. Protect duct interiors from the elements and foreign materials until building is enclosed. Follow SMACNA’s “Duct Cleanliness for New Construction.” Duct interiors shall be cleaned to meet the Intermediate Level of cleanliness.

Q. Paint interiors of metal ducts that do not have duct liner, for 24-inches upstream of registers and grilles. Apply one coat of flat, black, latex finish coat over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09 Painting Sections.

3.4 SEAM AND JOINT SEALING SCHEDULE

A. Seal externally insulated ducts before insulation installation.

B. Seal Class Schedule: Seal Class A and Leakage Class 4 is required for all ducts except as noted below.

1. Transfer air ducts and transfer air boots need not be sealed.

C. Rectangular Duct: Sealant materials and methods shall be at contractor’s option, chosen from among the products specified in Part 2 of this Section; provided that the above seal class and leakage class schedule is met.

D. Round Duct: Transverse joints shall be made with a SMACNA RT-1 interior slip coupling beaded at center, fastened to duct with screws; in addition, apply Two-Part Sealing System continuously around exterior side of joint.

1. Contractor’s Option: Furnish prefabricated round duct connection system consisting of self-sealing gasketed fittings. Round duct joints made with this type of fitting do not require the additional sealant specified above, provided that specified seal class is achieved.

3.5 HANGING AND SUPPORTING

A. Install rigid round, rectangular, and flat-oval metal duct with support systems indicated in SMACNA HVAC Duct Construction Standards – Metal and Flexible.

B. Support horizontal ducts within 24-inches of each elbow and within 48-inches of each branch intersection.

C. Support vertical ducts at maximum intervals of 16 feet and at each floor.

D. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.

E. Install concrete inserts before placing concrete.
F. Install powder-actuated concrete fasteners after concrete is placed and completely cured. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4-inches thick.

G. Repair any building insulation or building fireproofing materials, whether new or existing, that are removed or scraped away in order to attach hangers and supports, so as to maintain an equivalent insulation or fire rating as existed without said hanger or support attachment.

3.6 CONNECTIONS

A. Make connections to equipment with flexible connectors according to Division 23 Section “Duct Accessories.”

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

3.7 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections according to SMACNA HVAC Duct Construction Standards – Metal and Flexible and prepare test reports:

1. All indoor ducts if design pressure rating is greater than 3-inch w.g.

B. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.

C. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days’ advance notice for testing.

D. Maximum Allowable Leakage: Comply with requirements for Leakage Class 4.

E. Remake leaking joints and retest until leakage is equal to or less than maximum allowable.

3.8 CLEANING NEW SYSTEMS

A. Mark position of dampers and air-directional mechanical devices before cleaning, and perform cleaning before air balancing.

B. Use service openings, as required, for physical and mechanical entry and for inspection.

1. Create other openings to comply with duct standards.
2. Disconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling sections to gain access during the cleaning process.

C. Vent vacuuming system to the outside. Include filtration to contain debris removed from HVAC systems, and locate exhaust down wind and away from air intakes and other points of entry into building.

D. Clean the following metal duct systems 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. Blower coil 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, and actuators except in ceiling plenums and mechanical equipment rooms.

E. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet.
5. Clean coils and coil drain pans according to ACR 2006. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.

F. Cleanliness Verification:

1. Visually inspect metal ducts for contaminants.
2. Where contaminants are discovered, re-clean and reinspect ducts.

END OF SECTION
SECTION 23 33 00 – DUCT ACCESSORIES

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:
   2. Duct silencers.
   3. Turning vanes.
   4. Duct-mounted access doors.
   5. Flexible connectors.
   6. Flexible ducts.
   7. Duct accessory hardware.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.
B. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
B. Comply with AMCA 500-D testing for damper rating.

1.5 REFERENCED STANDARDS


PART 2 - PRODUCTS

2.1 MATERIALS

A. 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: Lock-forming quality; complying with ASTM A653/A653M and having G90 coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.

C. Aluminum Sheets: Comply with ASTM B209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
D. Extruded Aluminum: Comply with ASTM B221, Alloy 6063, Temper T6.

E. Minimum Thickness: All sheet steel used on this project shall be a minimum of 24-gage thickness, and all aluminum sheets shall be a minimum of 0.04-inch thickness, regardless of whether or not SMACNA standards permit thinner gage material.

F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

G. Tie Rods: Comply with Articles 2.5 through 2.9, including all accompanying Tables and Figures, of the SMANCA HVAC Duct Construction Standards.

2.2 MANUAL VOLUME DAMPERS

A. Manual volume dampers shall be standard leakage rating, with linkage outside airstream, suitable for horizontal or vertical applications. Volume dampers may be factory-manufactured or contractor-fabricated per SMACNA Fig. 7-4/7-5.

B. Material: Match material options throughout this subsection to the material of adjacent ductwork. For duct material, refer to Division 23 Section "Metal Ducts."

C. Frames: Hat-shaped channels with mitered and welded corners.

1. Galvanized-steel, 16-gage or 0.064-inch minimum thickness, for use in galvanized steel ducts.
2. The above requirements may be reduced to 20-gage for round dampers installed in round ducts.

D. Blades: Multiple-blade; single-blade if duct dimension is 12-inch or less in the direction perpendicular to damper axis. Parallel or opposed-blade design. Stiffen damper blades for stability.

1. Galvanized-steel, 16-gage or 0.064-inch thick, for use in galvanized steel ducts.
2. The above requirements may be reduced to 20-gage for round dampers installed in round ducts.

E. Blade Axles: Galvanized steel. Dampers shall have axles full length of damper blades, and bearings at both ends of operating shaft.

F. Bearings: Oil-impregnated bronze, molded synthetic, and stainless-steel sleeve-type are acceptable.

G. Tie Bars and Brackets: Galvanized steel.

H. Jackshaft:

2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

I. Damper Hardware:
1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch-thick zinc-plated steel, and a ¾-inch hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

2.3 DUCT SILENCERS

A. General: Factory-fabricated and -tested, rectangular silencer with performance characteristics and physical requirements as indicated. Refer to schedule on Drawings. Duct silencers may be referred to as “Sound Attenuators” on the Drawings.

B. Fire Performance: Adhesives, sealers, packing materials, and accessory materials shall have fire ratings not exceeding 25 for flame spread and 50 for smoke developed when tested according to ASTM E84.

C. Rectangular Units: Fabricate casings with a minimum of 22-gage solid sheet metal for outer casing and 26-gage perforated sheet metal for inner casing.

D. Interior Partitions and Baffles: At least 22-gage and designed for minimum aerodynamic losses.

E. Sheet Metal Perforations: 1/8-inch diameter for inner casing and baffle sheet metal.

F. Fibrous Acoustic-Fill Material: Inert and vermin-proof fibrous material, packed under not less than 5 percent compression.

G. Fabricate silencers to form rigid units that will not pulsate, vibrate, rattle, or otherwise react to system pressure variations.

   1. Do not use nuts, bolts, and sheet metal screws for unit assemblies.
   2. Lock form and seal or continuously weld joints.
   3. Suspended Units: Factory-installed suspension hooks or lugs attached to frame in quantities and spaced to prevent deflection or distortion.
   4. Reinforcement: Cross or trapeze angles for rigid suspension. Silencer shall withstand 8-inches wg pressure differential inside-to-outside without structural failure.

H. Source Quality Control: Perform the following factory tests:

   1. Acoustic Performance: Test according to ASTM E477, with airflow in both directions through silencer.
   2. Record acoustic ratings, including dynamic insertion loss and self-noise power levels, for both forward flow (air and noise in same direction) and reverse flow (air and noise in opposite directions) with airflow of at least 2000-fpm face velocity.
   3. Leak Test: Test units for air tightness at 200 percent of associated fan static pressure or 6-inch wg static pressure, whichever is greater.

2.4 TURNING VANES

A. 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. Comply with SMACNA’s “HVAC Duct Construction Standards – Metal and Flexible.”
1. Vane Construction: Double Wall.

2.5 DUCT-MOUNTED ACCESS DOORS

A. Duct-Mounted Access Doors: Factory-manufactured doors, airtight and suitable for duct pressure class.

B. Door: Double wall, rectangular, galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.

C. Insulation: 1-inch thick, fibrous-glass or polystyrene-foam board.

D. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.

E. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.

F. Number of Hinges and Locks: Two hinges, or continuous piano hinge, and two sash locks.

2.6 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 5¾-inches wide attached to 2 strips of 2¾-inch wide, 0.028-inch thick, galvanized sheet steel or 0.032-inch thick aluminum sheets. Provide metal compatible with connected ducts.

D. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene or polychloroprene.
   2. Service Temperature: Minus 40 to plus 200°F

2.7 FLEXIBLE DUCTS

A. General: Comply with UL 181, Class 1. Factory-fabricated, insulated, round duct, with an outer jacket enclosing glass-fiber insulation around a continuous inner liner.
   1. Reinforcement: Galvanized steel wire helix encapsulated in inner liner.
   3. Inner Liner: CPE film, acoustically transparent to mid-range sound energy.

B. Required Pressure Ratings:
   1. Sizes 12-inch and smaller: At least 8-inch wg positive and 1-inch wg negative.
   2. Sizes larger than 12-inch: At least 4-inch wg positive and ½-inch wg negative.

C. Velocity Rating: 4000 fpm.

D. Temperature Rating: -20°F to +250°F.

E. Thermal Rating: Minimum R-4.2 thermal resistance.
F. Flexible Duct Connector 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.

G. Provide flexible ducts with Flexflow elbow by Thermaflex for connections to air devices.

2.8 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.”

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel ducts.

C. Install backdraft dampers where indicated.

D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts.

1. Locate dampers at least two duct diameters from fittings and as far away as possible from outlets.
2. Install galvanized-steel volume dampers in galvanized-steel 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 duct silencers rigidly to ducts.

H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. Adjacent to and close enough to fire dampers, to reset or reinstall fusible links.
2. Elsewhere as indicated.

I. Install access doors with swing against duct static pressure.

J. Access Door Size: 18 by 10-inches unless noted otherwise.

K. Label access doors according to Division 23 Sections to indicate the purpose of access door.

L. Install flexible connectors to connect ducts to equipment.
M. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

N. Connect air devices to ducts directly or with a maximum 60-inch length of flexible duct clamped in place.

O. Install flexible ducts in accordance with the following:

1. Turn radius of flexible duct at duct centerline shall not exceed one times nominal duct diameter.
2. At least one support shall be installed for every run of flexible duct that is 60-inches long or longer; more if needed to comply with next paragraph.
3. Support flexible duct so that it does not contact nor rest upon light fixtures, sprinkler and other piping, ceilings and ceiling hanger wires, electrical conduits and cable tray, and similar items.
4. All supporting material surfaces in direct contact with supported flexible duct shall maintain a minimum of one-inch in contact width along full length of contact.
5. Comply with Figures 3-10 and 3-11 in SMACNA’s *HVAC Duct Construction Standards – Metal and Flexible*. 3rd ed. except where more stringent details are given on the Drawings.
6. Comply with Specifications 3.5, 3.6, and 3.7, paragraphs S3.19 through S3.40, of SMACNA’s *HVAC Duct Construction Standards – Metal and Flexible*. 3rd ed., except where more stringent requirements are specified herein.

P. 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. Inspect turning vanes for proper and secure installation.
SECTION 23 36 00 – AIR TERMINAL UNITS

PART 1 - GENERAL

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

1.1 SUMMARY
   A. This Section includes the following:
      1. Shutoff single-duct air terminal units.

1.2 SUBMITTALS
   A. Product Data: For each type of product indicated, include rated capacities; furnished specialties and accessories; shipping, installed, and operating weights; and sound-power ratings for each model indicated. Detail equipment assemblies and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection. Include a schedule showing unique model designation, room location, model number, size, and accessories furnished.

   B. Shop Drawings: For air terminal units. Include plans, elevations, sections, details, and attachments to other work. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection. Hangers and supports, including methods for duct and building attachment and vibration isolation.

   C. Wiring Diagrams: Detail wiring for power, signal, and control wiring and differentiate between manufacturer-installed and field-installed wiring.

   D. Field quality-control reports.

   E. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01, include instructions for resetting minimum and maximum air volumes and for adjusting software set points.

1.3 QUALITY ASSURANCE
   A. Product Options: Drawings indicate size, profiles, and dimensional requirements of air terminal units and are based on the specific system indicated. Refer to Division 23 Section “Basic Mechanical Requirements.”


   C. AHRI Certification: Only air terminals that are certified under the AHRI Standard 880 Certification Program and carry the AHRI Seal will be accepted.

1.4 COORDINATION

A. Coordinate layout and installation of air terminal units and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide Air Terminal Units by one of the following:

1. Carnes Co., Inc.
2. Krueger.
3. Nailor Industries, Inc.
5. Titus.
6. The Trane Co.

2.2 AIR TERMINAL UNITS, GENERAL

A. Configuration: Pressure independent terminal unit as scheduled; including volume-damper assembly inside unit casing with control components located inside a protective metal shroud. Unit sizes, capacities, maximum and minimum airflows, maximum noise ratings, and maximum air pressure drops shall be as scheduled on the Drawings.

B. Casing: Minimum 22-gage steel or 0.032-inch aluminum.

1. Air Inlets: Beaded round stub connection of length at least 2-inches beyond airflow sensor taps for inlet duct attachment.
2. Air Outlets: Rectangular S-slip and drive connections.
3. Access: Removable panels or access door for access to damper, heating coil, and other parts requiring service, adjustment, or maintenance; with airtight gasket.

C. Volume Damper: Minimum 22-gage galvanized steel with peripheral edge gasket and self-lubricating bearings. Include a mechanical hard stop to prevent over-stroking. Include permanent markings on damper shaft to indicate damper position by simple visual inspection.

D. Maximum Damper Leakage: AHRI 880 rated, 2 percent of nominal airflow at 3-inch wg inlet static pressure.

E. Airflow Sensor: Multipoint, multi-axis inlet velocity sensor with center averaging feature, factory installed and connected to the controller with UL-listed fire-retardant pneumatic tubing.

2.3 UNIT INSULATION

A. Flexible Elastomeric Liner: Comply with NFPA 90A.
2. Thickness: 1/2 inch minimum; thicker if required to meet specified or scheduled values for thermal and/or acoustic performance.
3. Thermal Conductivity (k-Value): 0.24 at 75°F mean temperature.
4. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM C411.
5. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A.

2.4 INTEGRAL ACCESSORIES

A. Multi-outlet Discharge Section: With duct collars as indicated on drawings; each with locking butterfly balancing damper.

2.5 INTEGRAL HYDRONIC HEATING COILS

A. Casing: Minimum 20-gauge galvanized steel, factory-installed, with flanged connection for ductwork.
B. Pressure Rating: Leak test to 300 psi air under water; minimum burst pressure of 2000 psi.
C. Performance Ratings: As scheduled on Drawings. Coils shall be designed, tested and rated according to AHRI 410.
D. Tube Construction: Copper, ½-inch O.D. with 0.016-inch minimum wall.
E. Fin Construction: Aluminum, 0.006-inch minimum thickness, not more than 12 per inch, mechanically-bonded to tubes.
F. Piping Connections: Male solder header. Coil connections shall be on the side of the unit indicated on the Drawings.

2.6 AIR TERMINAL UNIT CONTROLS

A. DDC Controller, differential pressure sensor and damper motor, shall be furnished by the BAS manufacturer for field mounting.

2.7 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
B. Steel Cables: Galvanized steel complying with ASTM A603.
C. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
D. Air Terminal Unit Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
E. Trapeze and Riser Supports: Steel shapes and plates for units with steel casings; aluminum for units with aluminum casings.
2.8 SOURCE QUALITY CONTROL

A. Identification: Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and AHRI certification seal.

B. Verification of Performance: Test and rate air terminal units according to AHRI 880 "Industry Standard for Air Terminals."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install air terminal units level and plumb, according to manufacturer’s written instructions, rough-in drawings, original design, and referenced standards. Maintain sufficient clearance for normal service and maintenance.

B. Protect all openings of air terminal units with filters or temporary covers throughout project storage, handling, and placement, to keep clean the interiors of air terminal units.

3.2 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA’s "HVAC Duct Construction Standards – Metal and Flexible," Chapter 4, “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 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.

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.

3.3 CONNECTIONS

A. Ductwork: Connect ductwork to air terminals according to Division 23 ductwork Sections and Details on Drawings.

B. Hot Water Piping: Connect heating coils to supply with shutoff valve, strainer, and union or flange; and to return with shutoff valve, control valve, balancing valve, and union or flange. Install piping adjacent to air terminal units to allow service and maintenance. Piping installation requirements are specified Division 23 Section "Hydronic Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
3.4 IDENTIFICATION

A. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Division 23 Section “Basic Mechanical Materials and Methods” for equipment labels and warning signs and labels.

3.5 FIELD QUALITY CONTROL

A. Complete installation and startup checks according to manufacturer’s written instructions, and perform the following field tests and inspections:

1. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
2. Verify that controls and control enclosure are accessible.
3. Verify that control connections are complete.
4. Verify that nameplate and identification tag are visible.
5. Verify that controls respond to inputs as specified.
6. After installing air terminal units, and after electrical circuitry (where applicable) has been energized, test for compliance with requirements.
7. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.
8. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Remove and replace malfunctioning units and retest as specified above.

3.6 CLEANING

A. After completing system installation, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes.

B. Vacuum clean the interior of air terminals if the openings were not protected during construction.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner’s maintenance personnel in proper adjustment, operation, troubleshooting, and maintenance of air terminal units. Refer to Division 01 for requirements.

END OF SECTION
SECTION 23 37 13 – DIFFUSERS, REGISTERS, AND GRILLES

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 ceiling- and wall-mounted diffusers, registers, and grilles.

B. Related Sections include the following:
   1. Division 23 Section “Duct Accessories” for fire dampers and volume-control dampers not integral to diffusers, registers, and grilles.
   2. Division 23 Section “Testing, Adjusting, and Balancing” for balancing diffusers, registers and grilles.

1.3 SUBMITTALS

A. Product Data: For each product indicated, include the following:
   1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
   2. Diffuser, Register, and Grille Schedule: Indicate Drawing designation, room location, quantity, model number, size, and accessories furnished.

B. Samples for Initial Selection: Submit manufacturer’s color charts showing the full range of colors available for diffusers, registers, and grilles with factory-applied color finishes; where required or indicated by note on Schedule.

C. Samples for Initial Selection: Submit sample diffusers, registers, and grilles with factory-applied color finishes; where required or indicated by note on Schedule.

1.4 QUALITY ASSURANCE


B. NFPA Compliance: Install diffusers, registers, and grilles according to NFPA 90A, “Standard for the Installation of Air-Conditioning and Ventilating Systems.” Where located less than 84 inches above finish floor, diffusers, registers and grilles shall be designed to prohibit passage of a 1/2-inch sphere.

C. Single-Source: Unless noted otherwise, a single manufacturer shall furnish all diffusers, registers, and grilles.
PART 2 - PRODUCTS

2.1 COMMON REQUIREMENTS, ALL UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Anemostat
2. Carnes Co.
4. Nailor Industries of Texas Inc.
5. Price Industries.
6. Titus; Air System Components LP.

B. Diffusers, registers, and grilles are scheduled on Drawings. All model numbers, finish designations, border types, and accessory designations are based on one manufacturer identified therein. Products by other manufacturers listed above may be furnished, but must be equal in all respects to the device identified, including but not limited to NC, pressure, and cfm ratings.

C. Diffusers, Registers, and Grilles Finish: Acrylic baked enamel paint.

D. Integral Balancing Damper: Where dampers are scheduled as an integral part of diffusers and grilles (registers), provide multi-blade gang-operated opposed-blade type, radial-style if used with round ducts; 24 gage galvanized steel. Integral dampers shall be operable from the room side of the diffuser or register without special tools.

E. Diffusers, Registers, and Grilles Mounting: Provide border frame mounting type as scheduled. If not scheduled, provide border frame mounting type compatible with ceiling or wall type indicated on Architectural Drawings. Distinguish between flush flat-tee lay-in ceilings, drop-face lay-in ceilings, and the narrow-tee or screw-slot lay-in ceilings by providing a border type specifically designed for each as applicable; a generic standard lay-in border frame will not be acceptable for multiple lay-in ceiling types.

2.2 PRODUCT SPECIFICATIONS

A. Register and Grille: Adjustable double-deflection supply grilles, single fixed deflection return grilles, of sizes and performance as scheduled. Blades shall be 24-gage steel; supply grille blades shall be individually adjustable and held in place without rattling or slip by tension wire or metal friction pivots. Frame shall be roll-formed 24-gage steel or with 1-inch minimum flange and full penetration welds at the corners. Exposed screw holes shall be countersunk for flush finish surface.

B. Other grilles, registers and diffusers not specified above may be specified on the Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment. Proceed with installation only after unsatisfactory conditions have been corrected.
B. Install diffusers, registers, and grilles level and plumb.

C. 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 practicable. 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.

D. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

E. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

F. After installation of diffusers, registers, and grilles, inspect exposed finish. Clean exposed surfaces to remove burrs, dirt, and smudges. Replace diffusers, registers, and grilles that have damaged finishes.

END OF SECTION
SECTION 23 82 19 – BLOWER COIL UNITS

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. Ducted blower coil units and accessories.

1.3 SUBMITTALS
   A. Product Data: For each type of product.
      1. Include rated capacities, operating characteristics, and furnished specialties and accessories.
   B. Shop Drawings:
      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.
   C. Field quality-control reports.
   D. Operation and Maintenance Data: For blower coil units to include in emergency, operation, and maintenance manuals.

1.4 EXTRA MATERIAL
   A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
      1. Blower Coil Unit Filters: Furnish one spare filter for each filter installed.
      2. Fan Belts: Furnish one spare fan belt for each unit installed.

1.5 QUALITY ASSURANCE
   A. Comply with NFPA 70.
   B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
   C. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."
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. Factory-packaged and -tested units rated according to AHRI 440, ASHRAE 33, and UL 1995.

2.2 BLOWER FAN COIL UNITS

A. Manufactures: Subject to compliance with requirements, provide products by one of the following:
   1. Carrier Corporation, a United Technologies Company.
   2. Daikin Appliances Inc.
   4. York, division of Johnson Controls, Inc.

B. Coil Section Insulation: 1-inch thick, foil-faced glass fiber complying with ASTM C 1071 and attached with adhesive complying with ASTM C 916.
   1. Surface-Burning Characteristics: Insulation and adhesive shall have a combined maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84 by a qualified testing agency.
   2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

C. Cabinets: Heavy Gauge Galvanized Steel.

D. Filters: Minimum arrestance and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2 and all addendums.

E. MERV Rating: 8 when tested according to ASHRAE 52.2.

F. Hydronic Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch, rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain.

G. Direct-Driven Fans: Double width, forward curved, centrifugal; with permanently lubricated, electrically commutated motor (ECM) resiliently mounted in the fan inlet. Aluminum or painted-steel wheels, and painted-steel or galvanized-steel fan scrolls.
   1. ECM Motors: Comply with requirements in Section 230513 "Motor."
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, to receive blower coil units for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for piping and electrical connections to verify actual locations before blower coil unit installation.

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

3.2 INSTALLATION

A. Install blower coil units level and plumb.

B. Install blower coil units to comply with NFPA 90A.

C. Suspend blower coil units from structure with elastomeric hangers.

D. Install new filters in each blower coil unit within two weeks after Substantial Completion.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:

1. Install piping adjacent to machine to allow service and maintenance.

B. Connect supply-air and return-air ducts to blower coil units with flexible duct connectors specified in Section 233300 "Air Duct Accessories." Comply with safety requirements in UL 1995 for duct connections.

C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 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 equipment installations, including connections.

C. Perform the following tests and inspections:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fan coil units.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. This Section specifies the basic requirements for electrical installations and includes requirements common to all sections of Division 26. It expands and supplements the requirements specified in sections of Division 01. This section is also applicable to Division 27 “Communications” and Division 28 “Electronic Safety and Security.”

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

C. Codes and Standards: All equipment, material and installations shall comply with applicable codes, standards, and installation practices. Comply with the requirements of the applicable local building code, the applicable NEC, all local rules and regulations including those of the fire authorities. Comply with all applicable NFPA standards. All material and equipment shall be listed by the Underwriters Laboratories (UL) standard that is applicable for the specific purpose of the material and equipment. The National Electrical Code, National Electrical Manufacturer’s Association (NEMA) Standards, and applicable ANSI and IEEE standards shall apply to the pertinent materials, equipment, and installation practices. Testing shall be in accordance with the applicable International Electrical Testing Association (NETA) standards.

1. These specifications include references to the 2011 edition of the NFPA 70 "National Electrical Code." Where a different version of the NEC has been adopted by the local Authority Having Jurisdiction, the references associated with that version of the standard shall be applicable.

1.2 SUMMARY OF WORK

A. The Contractor shall furnish and install all new materials as indicated on the drawings and specifications and all items required to make the electrical system complete and in working order.

B. System descriptions included in scope of work are as follows:

1. Electrical power systems, including luminaires, distribution equipment, motors, wiring devices, etc.
2. Grounding system.
3. Fire alarm system.
4. Power and communications for temperature control system.
5. Wiring of equipment furnished by others.
6. Selective demolition work and/or modification of existing systems and equipment.
7. Low voltage systems as described in Divisions 27 and 28.
8. Low voltage systems rough-in, as indicated on drawings, for installation of low voltage equipment by others.

C. Work not included:

1. Temperature control wiring for plumbing and HVAC equipment (unless otherwise indicated) shall be by other Contractors.
1.3 WORK SEQUENCE

A. All work that produces excessive noise and/or interference with normal building operations, as indicated on the drawings, shall be coordinated and scheduled with the Owner. Such work may require scheduling of work after occupied hours or weekends. The Owner reserves the right to determine when such work is conducted.

1.4 DIVISION OF WORK BETWEEN MECHANICAL, ELECTRICAL, CONTROLS AND LOW VOLTAGE CONTRACTORS

A. Division of work is the responsibility of the Prime Contractor.

1.5 ELECTRICAL COORDINATION DRAWINGS

A. Prepare a set of coordination drawings showing major elements, components, and systems of electrical equipment and materials in relationship with other building components. Prepare drawings to an accurate scale of 1/4 inch = 1 foot-0 inches or larger. Indicate the locations of all equipment and materials, including clearances for servicing and maintaining equipment.

B. Prepare floor plans, reflected ceiling plans, elevations, sections and details to conclusively coordinate and integrate all installations. Indicate locations where space is limited and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:

1. Equipment room layouts.
2. Specific equipment installations, including, but not limited to the following:
   a. Busways.
   b. Motor control centers.
   c. Generator set and automatic transfer switches.
   d. Transformers.
   e. Switchboards and panelboards.
   f. Equipment connections.
   g. Control panels.

3. Wiring diagrams: Indicating field-installed electrical power and control wiring and cabling layouts, overcurrent protective devices, equipment and equipment connections.
5. Exterior wall penetrations.
6. Ceiling plenums which contain piping, ductwork, or equipment in congested arrangements.
7. Exterior underground lines.
8. Locate, identify and protect electrical services passing through remodeling or demolition area and serving other areas required to be maintained operational. When transit services must be interrupted, provide temporary services for the affected areas and notify the Owner prior to changeover.

C. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls and other structural components as they are constructed.

D. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."
E. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section “Penetration Firestopping.”

1.6 QUALITY ASSURANCE

A. Contractor’s Responsibility Prior to Submitting Pricing/Bid Data:

1. The Contractor shall thoroughly review the contract documents and specifications and visit the site prior to issuing bid. Resolve all reported deficiencies with the Architect or Engineer prior to awarding any subcontracts, ordering material, or starting any work with the Contractor’s own employees. Any work performed prior to receipt of instructions from the Architect or Engineer will be done at the Contractor’s risk.

B. Qualifications:

1. Only products of specified manufacturers, or approved equals as determined by the Engineer, are acceptable.
2. All Contractors and Subcontractors shall employ only workmen who are skilled in their trades.

C. Compliance with Codes, Laws, and Ordinances:

1. Conform to all requirements of the state, city and local codes, laws and ordinances and other regulations having jurisdiction over this installation.
2. Conform to all published standards of Indiana University.
3. If there are any discrepancies between the codes and regulations and these specifications, the Engineer shall determine the method or equipment to be used.
4. If the Contractor notes, at the time of the bidding, any parts of the drawings or specifications that do not comply with the codes or regulations, the Contractor shall inform the Architect or Engineer in writing, requesting a clarification. If there is insufficient time for this procedure, the Contractor shall submit with his proposal a separate price to make the system comply with the codes and regulations.
5. If there is any discrepancy between a manufacturer’s recommendation and these specifications, inform the Architect or Engineer in writing requesting a clarification.
6. If there are no local codes having jurisdiction, the current issue of NFPA 70 “National Electrical Code” shall be followed.

D. Examination of Drawings:

1. The drawings for the indicated work are diagrammatic, intended to convey the scope of the electrical work and to indicate the general arrangements and locations of equipment, wiring devices, etc., and the approximate sizes of equipment. Field verification of dimensions on plans is required. The actual conditions, including heights, lengths and orientation shall be the basis of the work.
2. The architectural, structural, mechanical and electrical drawings and specifications shall be considered as mutually explanatory and complementary. Any electrical work called for by one and not by the other shall be performed as though required by all. All sections and subsections of the Electrical work shall be governed by and subject to the general and supplementary conditions. Any discrepancies in or between the drawings and specifications, or between the
drawings and actual field conditions shall be reported to the Architect or Engineer in sufficient time to issue an addendum for clarification.

3. Contractor shall determine the exact locations for equipment and rough-ins, and the exact routing of raceways.

4. Drawings shall not be scaled to determine equipment and system locations.

5. Not all required components are shown on the documents, including junction boxes, pull boxes, conduit fittings, etc. Contractor shall provide all components required for proper installation of the work.

6. Any item either shown on the drawings or called for in the specifications shall be included in this contract.

7. The Contractor shall determine quantities and quality of material and equipment required from the documents. Where discrepancies arise between drawings, schedules and/or specifications, the more expensive or higher quality amount shall be provided by the contractor.

8. Where used in electrical documents the word “furnish” shall mean supply for use, the word “install” shall mean connect up complete and ready for operation, and the word “provide” shall mean to supply for use and connect up complete and ready for operation.

9. Any item listed as furnished shall also be installed unless otherwise noted.

10. Any item listed as installed shall be furnished unless otherwise noted.

E. Electronic Media and Files:

1. Construction drawings for this project have been prepared Revit MEP 2014.

2. Contractors and Subcontractors may request electronic media files of the contract drawings and/or copies of the specifications. Specifications will be provided in PDF format.

3. Upon request for electronic media, the Contactor shall complete and return a signed "Electronic File Transmittal" form provided by Ross & Baruzzini.

4. If the information requested includes floor plans prepared by others, the Contractor shall be responsible for obtaining approval from the appropriate Design Professional for use of the part of the document.

5. The electronic contract documents can be used for preparation of shop drawings and record drawings only. The information may not be used in whole or in part for any other project.

6. The drawings prepared by Ross & Baruzzini for bidding purposes may not be used directly for raceway layout drawings or coordination drawings.

7. The use of these Revit documents by the Contractor does not relieve them from their responsibility for coordination of work with other trades and verification of space available for the installation.

8. The information is provided to expedite the project and assist the Contractor with no guarantee by Ross & Baruzzini as to the accuracy or correctness of the information provided. Ross & Baruzzini accepts no responsibility or liability for the Contractor’s use of these documents.

1.7 ROUGH-IN

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

B. Coordinate equipment rough-in requirements with Divisions 02 through 28.
1.8 CONTRACTOR'S SUBMITTAL REVIEW RESPONSIBILITIES

A. General: Submittals are not requested for all products covered in the specifications. Submit only the data requested under the submittals portion of each specification section or where indicated in a Submittal Log, if included within Division 01. Un-requested submittals will not be processed, reviewed or returned and the contractor will be notified that the submittal will not be reviewed by the engineer of record.

1. Non-request of submittals, when so noted, is not to be construed as an allowance for substitutions and does not relieve the contractor from full compliance with the plans and specifications.

2. Any deviation from specified items is considered a substitution. If the contractor desires to use other than specified items, then a formal request for substitution must be submitted prior to bid date (no exceptions), in accordance with the procedures and time limitations set forth in Division 01. Where not defined in Division 01, requests for substitutions shall be submitted no less than ten (10) working days prior to bid date. Review of substitution requests by the Engineer shall be done at the expense of the contractor. Charges for this substitution review shall be calculated based on the Engineer's standard hourly rates, as defined in their contract with the Owner.

B. It is the responsibility of the Contractor to ensure that all submittals have been reviewed for total completeness and accuracy as to the requirements of the specifications and drawings before being submitted to the Engineer for review.

1. One comprehensive submittal shall be provided for each individual specification section. All required submittal information called for in each individual specification section shall be included in the submittal.

2. The Engineer of Record shall not be responsible for informing the contractor on items that have not been included and are necessary for a complete review of the required submittal information for a specification section.

3. The Engineer of Record shall have the option of returning any submittal, unmarked, if all required documentation called for in the specifications has not been provided in the submittal.

4. The Engineer of Record shall review each submittal no more than two (2) times and return to the contractor with the appropriate disposition.

5. If the Engineer of Record is required to review a submittal a second time, it shall be limited to review of the changed information, clearly highlighted by the submitter, and/or confirmation of documentation only and it shall be returned to the contractor with the appropriate disposition.

6. If the submittal is required to be reviewed a third time, it shall be done at the expense of the contractor. Charges for this additional submittal review shall be calculated based on the Engineer's standard hourly rates, as defined in their contract with the Owner.

C. Operation and Maintenance Manuals: All items required for insertion into each Operation and Maintenance (O&M) Manual are called out in the submittals portion of each specification section or in a Submittal Log, if included within Division 01. It is the responsibility of the Contractor to ensure that the O&M submittal has been reviewed and includes all the requirements of the specifications. The Engineer of Record shall review the submittal for the Operation and Maintenance Manual one (1) time and return to the contractor with the appropriate disposition.

1. If the submittal is required to be reviewed a second time, it shall be done at the expense of the contractor. Charges for this additional submittal review shall be
calculated based on the Engineer’s standard hourly rates, as defined in their contract with the Owner.

2. Submittals for the Operation and Maintenance Manual must be original documentation.
3. Photo copies of marked up Operations and Maintenance submittals are not acceptable.

D. Coordination Drawings: Prepare and submit Coordination Drawings as further described herein and as indicated in the Special Conditions. The Engineer shall receive one copy of all coordination drawings supplied to the Owner as required in this specification. It is the responsibility of the Contractor to coordinate the work as outlined herein. Receipt by the Engineer of a copy of the coordination drawings is to verify conformance to the submittal requirements set forth in this specification section. It is not an admission by the Engineer as to the accuracy or completeness of the coordination proposed.

E. Refer to Division 01 and each individual Division 23 Section for additional submittal requirements.

1.9 ELECTRICAL SUBMITTALS

A. General: Submittals are not requested for all products covered in the specifications. Submit only the data requested under the submittals portion of each specification section. Un-requested submittals will not be processed or reviewed. FAX or photo copies are not allowed as submittals for operating and maintenance manuals. Submittals for operating and maintenance manuals must be on original manufacturer printed stock. Non-requirement of submittals, when so noted, is not to be construed as an allowance for substitutions and does not relieve the Contractor from full compliance with the plans and specifications. Any deviation from specified items is considered a substitution. If the Contractor desires to use other than specified items, then a formal request for substitution must be submitted prior to bid date, in accordance with the methods and times indicated in these specifications.

B. Definitions:

1. Product Data: Pre-printed manufacturer’s data.
2. Shop Drawings: Drawings made specifically for the manufacture of a particular piece of equipment to be used on this project.
3. Operation and Maintenance Data: Information containing instructions on the proper operation, maintenance and repair of the equipment, complete with written text, diagrams, photos, exploded views and parts lists.
4. Record Documents: Information indicating the actual installed conditions of the project on Mylar, electronic media, photographs or typed paper. Submit type, quantities and on media specified where indicated to be submitted.

C. The Contractor shall thoroughly review and approve all shop drawings before submitting them to the Architect/Engineer. Contractor’s approval stamp is required on all submittals. Approval will indicate the Contractor’s review of all material and a complete understanding of exactly what is to be furnished. Contractor shall clearly mark all deviations from the contract documents on all submittals. If the Contractor does not mark deviations, then the item shall be required to meet all drawing and specification requirements.

D. Where more than one model is shown on a manufacturer’s sheet, clearly indicate exactly which item and which data is relevant to the work.
E. Where the manufacturer lists multiple part numbers or options on a single data sheet, the part number and options to be used shall be clearly set apart from other part numbers shown on that sheet.

1.10 PRODUCT OPTIONS AND MATERIAL SUBSTITUTIONS

A. Where two or more materials are listed in the “Part 2 – Products” subsection of any Division 26, 27 or 28 section, do not assume that the selection of materials is the contractor’s option. Refer to “Part 3 – Execution” subsection of that same specification section for an explanation of which specific material(s) shall be used for which specific application(s). For example, Part 2 may list several types and grades of conductors, and Part 3 will describe which type and grade of conductors to use for a given application.

B. When two or more items of same material or equipment are required they shall be of the same manufacturer. Product manufacturer uniformity does not apply to raw materials, bulk materials, wire, conduit, fittings, sheet metal, steel bar stock, welding rods, solder, fasteners, motors for dissimilar equipment units, and similar items used in Work except as otherwise indicated.

C. Provide products which are compatible within systems and other connected items.

D. Substitutions: Products other than those specified must be submitted, approved and secured in writing from the Architect/Engineer via Addendum. If requested, a sample of the proposed substitution may be submitted to the Architect/Engineer for evaluation. This sample shall be supplied at no cost to the Architect/Engineer, and will be returned to the Contractor, at the Contractor’s expense at the end of the evaluation period.

E. Where several manufacturers’ names are given, the manufacturer for which a catalog number is given is the basis of design and establishes the quality required.

F. Any material, article or equipment of other unnamed manufactures which will adequately perform the services and duties imposed by the design and is of a quality equal to or better than the material, article or equipment identified by the drawings and specifications may be used if approval is secured in writing from the Architect or Engineer via Addendum. The Contractor assumes all costs incurred as a result of using the offered material, article or equipment, on his part or on the part of other Contractors whose work is affected.

G. Voluntary add or deduct prices for alternate materials may be listed on the bid form. These items will not be used in determining the low bidder. This Contractor assumes all costs incurred as a result of using the offered material or equipment on his part or on the part of other Contractors whose work is affected.

H. All material substitutions requested after the final Addendum must be listed as voluntary changes on the bid form.

1.11 PRODUCT, DELIVERY, STORAGE, HANDLING AND MAINTENANCE

A. Deliver products to project properly identified with names, model numbers, types, grades, compliance labels and similar information needed for distinct identifications; adequately packaged and protected to prevent damage during shipment, storage and handling. Protect stored equipment and materials from damage.
B. Coordinate deliveries of electrical materials and equipment to minimize construction site congestion. Limit each shipment of materials and equipment to the items and quantities needed for the smooth and efficient flow of installations. If not noted on the drawing, it is the Contractor's responsibility to review the site prior to bid for path locations and any required building modifications to allow movement of equipment.

C. Exercise care in transporting and handling to avoid damage to materials. Store materials on the site to prevent damage.

D. Keep all materials clean, dry and free from damaging environments.

1.12 MISCELLANEOUS MATERIALS

A. Miscellaneous Materials Include:

1. Miscellaneous metals for support of electrical materials and equipment.
2. Wood grounds, nailers, blocking, fasteners and anchorage for support of electrical materials and equipment.
3. Concrete bases for equipment.
4. Sealers for sealing around electrical materials and equipment; and for sealing penetrations in floors and walls.
5. Access panels and doors in walls, ceilings, and floors for access to electrical materials and equipment.

1.13 WARRANTIES

A. Refer to the Division 01 "Closeout Procedures" for procedures and submittal requirements for warranties. Refer to individual equipment specifications for warranty requirements.

B. Compile and assemble the warranties specified in Division[s] 26[, 27 and 28] into a separated set of vinyl covered, three-ring binders, tabulated and indexed for easy reference.

C. Provide complete warranty information for each item to include product or equipment, date of beginning of warranty or bond; duration of warranty or bond; and names, addresses, telephone numbers and procedures for filing a claim and obtaining warranty services.

D. Warranty requires correction of all work found to be defective or nonconforming to the Contract Documents, without cost to the Owner. The Contractor shall bear all costs associated with corrective measures and damage due to defects or nonconformance with the Contract Documents, excluding repairs required as a result of improper maintenance or operation, or normal wear and tear as determined by the Architect/Engineer.

PART 2 - PRODUCTS

2.1 MISCELLANEOUS LUMBER

A. All lumber shall be fire-treated.

B. Framing Materials: Standard Grade, light-framing-size lumber of any species. Number 3 Common or Standard Grade boards complying with WCLIB or AWPA rules, or Number 3
boards complying with SPIB rules. Lumber shall be preservative-treated in accordance with AWPB LP-2, and kiln-dried to a moisture content of not more than 19 percent.

2.2 ACCESS DOORS

A. Steel Access Doors and Frames: Factory-fabricated and assembled units, complete with attachment devices and fasteners ready for installation. Joints and seams shall be continuously welded steel, with welds ground smooth and flush with adjacent surfaces.

B. Frames: 16-gage steel, with a 1-inch-wide exposed perimeter flange for units installed in unit masonry, pre-cast, or cast-in-place concrete, ceramic tile or wood paneling.

C. For Installation in Masonry, Concrete, Ceramic Tile, or Wood Paneling: 1 inch-wide-exposed perimeter flange and adjustable metal masonry anchors.

D. For Gypsum Wallboard or Plaster: Perforated flanges with wallboard bead.

E. For Full-Bed Plaster Applications: Galvanized expanded metal lath and exposed casing bead, welded to perimeter of frame.

F. Flush Panel Doors: 14-gage sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175 degrees; factory-applied prime paint.

G. Fire-Rated Units: Insulated flush panel doors with continuous piano hinge and self-closing mechanism.


I. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Bar-Co., Inc.
2. J.L. Industries.
5. Nystrom, Inc.

2.3 SLEEVES FOR RACEWAYS AND CABLES


1. Minimum Metal Thickness:

   a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).

   b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section “Penetration Firestopping.”
2.4 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Manufacturers: Subject to compliance with requirements. Provide products by one of the following
   a. Advance Products & Systems, Inc.
   b. Calpico, Inc.
   c. Metraflex Co.
   d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: NBR interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.

3. Pressure Plates: Carbon steel. Include two for each sealing element.

4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.5 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time and recommended for interior and exterior applications.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounted items.

C. 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.

D. 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.

E. Right-of-Way: Give to piping systems installed at a required slope.

F. Jobsite Safety: The Contractor is the sole entity responsible for jobsite safety.

3.2 EXAMINATION

A. Examine substrates, areas, and conditions, with installer present, for compliance with requirements for installation tolerances and other conditions affecting installation and
application of sealants and access panels. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Install equipment and materials in accordance with manufacturer instructions and the requirements in Section 20 0800 "Seismic Protection."

3.3 ROUGH-IN

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

B. Coordinate equipment rough-in requirements with Divisions 02 through 28.

3.4 ELECTRICAL INSTALLATIONS

A. Coordinate electrical equipment and materials installation with other building components.

B. Verify all dimensions by field measurements.

C. Arrange for chases, slots, and openings in other building components to allow for electrical installations.

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

E. Sequence, coordinate and integrate installations of electrical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing-in the building.

F. Coordinate connection of electrical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.

G. Install systems, materials and equipment to conform to project requirements and approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Engineer.

H. Systems, materials and equipment which will be exposed in finished areas shall be installed level and plumb, parallel and perpendicular to other building systems and components.

I. Install electrical services and overhead equipment to provide the maximum headroom possible where mounting heights are not detailed or dimensioned.

J. Install electrical equipment to facilitate maintenance and repair or replacement of equipment components. Maintain code clearances in front of and about all electrical equipment. As much as practical, connect equipment for ease of disconnecting with minimum of interference with other installations.
K. Coordinate the installation of electrical materials and equipment above ceilings with suspension system, mechanical equipment and systems and structural components.

L. Include in the Work all labor, materials, equipment, services, apparatus and drawings (in addition to the Contract Documents) as required to complete the intended Work.

M. Control and interlock wiring shall be installed in a separate raceway and shall not be installed in the same raceway as power conductors.

N. Only new, clean and perfect equipment, apparatus, materials and supplies of latest design and manufacture shall be incorporated in the Work in order to assure an electrical system of high quality.

O. The Work required to be done by the Contractor, the Utility companies and the Owner, in order to obtain utility services such as telephone and electric, is delineated in these specifications and on the drawings. Unless otherwise noted, construction or connection charges (except for temporary power) by those companies shall be paid by the Owner.

P. Determine electrical utility elevations prior to installation and coordinate with other trades. Installation priorities at a minimum shall be as follows:

1. Luminaires.
2. Gravity flow piping, including steam and condensate.
3. Electrical bus duct.
4. Sheet metal.
5. Cable trays, including access space.
6. Other piping.
7. Conduits and wireway.

3.5 CONNECTIONS TO EQUIPMENT AND APPLIANCES

A. In many instances the drawings show an outlet box and power supply for specific equipment, be it Owner- or Contractor-furnished. It is to be understood, unless otherwise noted, that the Work includes a connection from the box to the equipment or appliance. Verify circuit conductor quantities and sizes and overcurrent device number of poles and rating as well as any special grounding requirements, for all Owner-furnished equipment and adjust the required work accordingly.

B. Owner Furnished Equipment:

1. The Owner will supply the following items for installation and/or connection by this Contractor:
   a. [List...]

2. The following items shall be relocated, installed and/or connected by this Contractor:
   a. [List...]

3. The Owner will supply manufacturer’s installation data for new equipment purchased by owner for this project.
4. This Contractor shall make all electrical system connections shown on the drawings or required for fully functional units.
5. This Contractor shall be responsible for all damage to Owner-furnished equipment caused during installation.

3.6 CUTTING AND PATCHING

A. General: Perform cutting and patching in accordance with Division 01 Section "Execution." In addition to the requirements specified in Division 01, the following requirements apply:

1. Perform cutting, fitting and patching of electrical equipment and materials required to:
   a. Uncover Work to provide for installation of ill-timed Work.
   b. Remove and replace defective Work.
   c. Remove and replace Work not conforming to requirements of the Contract Documents.
   d. Remove samples of installed Work as specified for testing.
   e. Install equipment and materials in existing structures.
   f. Cut, remove, and legally dispose of selected electrical equipment, components, and materials as indicated, including but not limited to, removal of electrical items indicated to be removed and items made obsolete by the new Work.

2. Coordinate the cutting and patching of building components to accommodate the installation of electrical equipment and materials.
   a. Protect the structure, furnishings, finishes and adjacent materials not indicated or scheduled to be removed.
   b. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

3.7 CONCRETE BASES

A. Provide concrete bases for all floor-mounted electrical equipment, except that stand alone dry type transformers with integral floor channels may be placed without equipment bases when located in finished areas and electrical closets.

B. Form concrete equipment bases using nominal 2 inch by 4 inch framing lumber (use larger framing if larger pads, such as for engine-generators are required) with form release compounds. Locate as indicated and construct 4 inches larger in both directions than supported unit. Except where otherwise indicated, pour bases 4 inches higher than surrounding slab. Anchor or key to floor slab in accordance with Section 200800 "Seismic Protection." Chamfer top edges and corners.

C. Concrete materials and workmanship required for the Contractor’s work shall be provided by him. Materials and workmanship shall conform to the applicable standards of the Portland cement Association. Reinforce with 6-inch x 6-inch, W1.4-W1.4 welded wire fabric. Concrete shall withstand 3,000 pounds compression per square inch at twenty-eight days.

D. Where the base is less than 12-inches from a wall, the base shall be carried to the wall to prevent a “dirt-trap.”

E. Place concrete and allow to cure before installation of equipment.
3.8 ERECTION OF METAL SUPPORTS AND ANCHORAGE
A. Cut, fit, and place miscellaneous metal fabrications accurately in location, alignment and elevation to support and anchor electrical materials and equipment.
B. Field Welding: Comply with AWS "Structural Welding Code."

3.9 ERECTION OF WOOD SUPPORTS AND ANCHORAGE
A. Cut, fit and place wood grounds, nailers, blocking and anchorage accurately in location, alignment and elevation to support and anchor electrical materials and equipment.
B. Select fastener sizes that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood members.
C. Attach to substrates as required to support applied loads.

3.10 APPLICATION OF SEALERS
A. General: Comply with sealer manufacturers’ printed application instructions applicable to products and applications indicated, except where more stringent requirements apply.
B. Tooling: Immediately after sealant application and prior to time shrinking or curing begins, tool sealants to form smooth, uniform beads; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

3.11 INSTALLATION OF ACCESS DOORS
A. Set frames accurately in position and securely attached to supports with face panels plumb and level in relation to adjacent finish surfaces.
B. Adjust hardware and panels after installation for proper operation.

3.12 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS
A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
E. Cut sleeves to length for mounting flush with both surfaces of walls.
F. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.

G. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable, unless indicated otherwise.

H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
   1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.

I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."

J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."

K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel cast-iron pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.13 SLEEVE-SEAL INSTALLATION

A. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve.

B. Install to seal exterior wall penetrations.

C. Install in concrete slabs and walls and all other fire-rated floors and walls for raceways and cable installations. Provide insulated bushings at each end of sleeve. For sleeves through fire rated-wall or floor construction, apply UL-listed firestopping sealant in gaps between sleeves and enclosed conduits and cables.

   1. Conduit Seals: Install seals for conduit penetrations of slabs on grade and exterior walls below grade and where indicated. Tighten sleeve seal screws until sealing grommets have expanded to form watertight seal.

3.14 FIRESTOPPING

A. Apply rated firestopping sealants at all penetrations of fire and smoke walls; at all penetrations of floors and at other locations as noted on the drawings or where required by Code. Consider walls that are common to different abutting buildings, to different additions to buildings, and to fire and smoke separations within buildings as requiring
firestopping sealant. Refer to architectural drawings. For existing buildings where fire separations are not noted on any drawings, use reasonable logic as to which separations are fire-rated. When in doubt, consult with Engineer or Architect.

B. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

3.15 PAINTING

A. Paint all equipment that is marred or damaged prior to the Owner’s acceptance. Paint and color shall match original equipment paint and shall be obtained from the equipment supplier if available. All equipment shall have a finished coat of paint applied unless specifically allowed to be provided with a prime coat only.

B. Equipment in finished areas that will be painted to match the room finish will be painted by others. Should this Contractor install equipment in a finished area after the area has been painted, he shall have the equipment and all its supports, hangers, etc., painted to match the room finish. Painting shall be performed as described in the project specifications.

C. Equipment cabinets, casings, covers, metal jackets, etc., located in equipment rooms or concealed spaces, shall be furnished in standard finish, free from scratches, abrasions, chippings, etc.

D. Equipment in occupied spaces, or if standard to the unit, shall have a baked primer with based enamel finish coat free from scratches, abrasions, chipping, etc. If color option is specified or is standard to the unit, verify with the Architect or Engineer his color preference prior to ordering.

E. Paint all equipment in unfinished areas such as boiler room, mechanical spaces, and storage rooms. Equipment furnished with a suitable factory finish need not be painted; provided the factory-applied finish is not marred or spattered. If so, equipment shall be refinished with the same paint as the factory applied.

F. Do NOT paint electric conduits in crawl spaces, tunnels, or spaces above suspended ceilings. Except where conduit is in a damp location give exposed threads at joints two coats of sealer after joint is made up.

G. After surfaces have been thoroughly cleaned and are free of oil, dirt or other foreign matter, paint all raceway and equipment with the following:

1. Bare Metal Surfaces: Apply one coat of metal primer suitable for the metal being painted. Finish with two coats of alkyd base enamel paint.

3.16 ADJUST AND CLEAN

A. Thoroughly clean all equipment and systems prior to the Owner’s final acceptance of the project.

B. Clean all foreign paint, grease, oil, dirt, labels, stickers, etc., from all equipment.

C. Remove all rubbish, debris, etc., accumulated during construction from the premises.
D. Refer to the Division 01 Section "Closeout Procedures" for general requirements for final cleaning.

3.17 SPECIAL REQUIREMENTS

A. Coordinate the installation of all equipment, controls, devices, etc., with other trades to maintain clear access area for servicing.

B. Install all equipment to maximize access to parts needing service or maintenance. Review the final location, placement and orientation of equipment with the Owner’s representative prior to setting equipment.

C. Installation of equipment or devices without regard to coordination of access requirements and confirmation with the Owner’s representative will result in removal and reinstallation of the equipment at the Contractor’s expense.

3.18 SYSTEM COMMISSIONING

A. The electrical systems shall be complete and operating. System start-up, testing, balancing and satisfactory system performance is the responsibility of the Contractor. This includes all calibration and adjustment of electrical controls, balancing of loads, troubleshooting and verification of software, and final adjustments that may be needed.

B. All operating conditions and control sequences shall be tested during the start-up period. Testing all interlocks, safety shut-downs, controls and alarms.

1. The Contractor, subcontractors, and equipment suppliers shall have skilled technicians to ensure that all systems perform properly. If the Architect or Engineer is requested to visit the job site for troubleshooting, assisting in start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period, through no fault of the design; the Contractor shall reimburse the Owner on a time and materials basis for services rendered at the Architect or Engineer’s standard hourly rates in effect when the services are requested. The Contractor shall pay the Owner for services required that are project-, installation- or workmanship-related. Payment is due within 30 days after services are rendered.

3.19 FIELD QUALITY CONTROL

A. General:

1. All required equipment and systems tests shall be made during and post-Construction as required.
2. All required testing instruments, meters, etc., shall be provided.
3. Technicians operating testing equipment shall be trained in testing procedures.
4. Testing shall confirm that equipment and systems provided by the Contractor have been installed properly.
5. Unsatisfactory test results shall result in revisions or replacement of equipment or settings as required to provide a system capable of meeting test requirements. Tests shall be repeated or additional tests made as necessary to confirm system capability as required by the Owner, Engineer or Authority Having Jurisdiction.
3.20 EXCAVATION, FILL, BACKFILL, COMPACTION, AND RESTORATION

A. General:
   1. Prior to any excavation or digging, verify all underground utility locations. Contact all location services with sufficient time allowance for completion of utility location documentation.
   2. All excavation, fill, backfill, compaction and restoration required for this Contractor’s scope of work shall be provided by the Contractor unless noted otherwise.

B. Excavation:
   1. Excavations shall be made to proper dimensions and to accurate, solidate and undisturbed earth.
   2. Any excavations that exceed the depth requirements shall be provided by the Contractor with concrete of the same characteristics for foundations or compacted sand gravel fill. The type of fill shall be determined by the Architect or Engineer.
   3. Do not damage surrounding structures, equipment or buried pipe. Do not undermine footing or foundation.
   4. Protect all excavations to prevent cave-ins and risk to workmen.
   5. Saw-cut pavement or concrete surfaces where required for excavation with clean edges.
   6. Notify Architect or Engineer if bearing soil is not found to be adequate and halt excavation operation until given direction from the Architect or Engineer.
   7. Contractor shall confirm the soil conditions at their own cost. Excavations shall be conducted as required in the documents.
   8. A compacted bed of sand and gravel (minimum of 3 inches deep) shall be provided where trench is excavated in rock.

C. Dewatering:
   1. All trenches and pits shall be kept free of accumulation of water. Contractor shall provide all required equipment.

D. Underground Obstructions:
   1. Any known underground piping, conduit, feeders, foundations, and other obstructions in the vicinity of construction are indicated on the drawings. Review all trades’ Bid Documents on the project to determine obstructions indicated. Take precaution in making installations near underground obstructions.
   2. If objects not indicated on the drawings are encountered, remove, relocate or perform extra work as indicated by the Architect or Engineer.

E. Fill and Backfilling:
   1. Furnish all necessary sand and material for backfilling. Waste material and garbage are not acceptable materials.
   2. Remove excess excavated earth as directed.
   3. Backfill materials shall be suitable for required compaction, clean and free of perishable materials, frozen earth, debris, earth with a high void content, and stones greater than 4 inches in diameter. Water is not permitted to remain in un-backfilled trenches.
4. All trenches and excavations shall be backfilled immediately after completion of conduit installation or forms removal unless otherwise noted.

5. Areas around piers, independent foundations or structures shall have backfilled on all sides to prevent displacement. Fill and backfill shall be spread uniformly.

6. All conduits that are not concrete encased shall be provided with a bed of a minimum of 3 inches depth of compacted sand. Backfill shall be provided with compacted layers above the conduits.

7. Provide sand backfill to grade for all conduits under slabs or paved areas. All other conduits shall have sand backfill to 6 inches above the top of the conduit.

8. Backfill shall be made in layers of sand not exceeding 6 inches in depth.

9. Protect surface to prevent loads from the top of the surface for a minimum of 48 hours after backfilling operation.

F. Surface Restoration:

1. Areas shall be restored to the original condition, including areas that are landscaped. Replace all planting and landscaping features removed or damaged to its original condition. At least 6 inches of topsoil shall be applied where disturbed areas are to be seeded or sodded. All lawn areas shall be sodded unless seeding is called out in the drawings or specifications.

2. Concrete or asphalt type pavement and other surfaces removed or damaged shall be replaced to original condition. Broken edges shall be saw cut and repaired as directed by Architect or Engineer.

3.21 ENGINEER OBSERVATION OF WORK

A. The Contractor shall provide a minimum of seven (7) calendar days notice to the Engineer prior to:

1. Backfill of underground and under slab utilities.
2. Enclosing exterior walls, interior partitions and chases.
3. Installation of hard or suspended ceilings and soffits.

B. The Engineer will review the installation and provide a written report noting deficiencies requiring correction. The Contractor’s schedule shall account for these reviews in their schedule.

C. Above-Ceiling Final Observation:

1. All work above the ceilings must be completed prior to the Engineer’s review. This includes, but is not limited to:

   a. All junction boxes are closed and identified in accordance with Section 26 0553 "Identification for Electrical Systems."
   b. Luminaires, including ceiling-mounted exit and emergency lights, are installed and operational.
   c. Luminaire whips are suspended and supported above the ceiling.
   d. Conduit identification is installed in accordance with Section 26 0553 "Identification for Electrical Systems."
   e. Luminaires are suspended independently of the ceiling system when required by these contract documents.
   f. All wall penetrations have been sealed.
2. In order to prevent the Above-Ceiling Final Observation from occurring too early, the Contractor shall review the status of the work and certify, in writing, that the work is ready for the Above Ceiling Final Observation.

3. It is understood that if the Engineer finds the ceilings have been installed prior to this review and prior to seven days elapsing, the Engineer may not recommend further payments to the Contractor until such time as full access has been provided.

3.22 OPERATION AND MAINTENANCE DATA

A. Refer to the Division 01 Section: “Closeout Procedures” for procedures and requirements for preparation and submittal of maintenance manuals.

B. In addition to the information required by Division 01 for Maintenance Data, include the following information:

1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of all replaceable parts.

2. Manufacturer’s printed operating procedures to include start-up, break-in, routine and normal operating instructions, regulation, control, stopping, shut-down, and emergency instructions; and summer and winter operating instructions.

3. Maintenance procedures for routine preventive maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.

4. Servicing instructions and lubrication charts and schedules.

C. Submit three (3) properly indexed and bound copies in “D” ring style notebooks, of the Operations and Maintenance Instructions to the Architect or Engineer. Make all corrections or additions required.

D. Operation and Maintenance Instructions shall include:

1. Notebooks shall be heavy duty locking three-ring binders, black in color, and incorporate clear vinyl sheet sleeves on the front cover and spine for slip-in labeling. “Peel and stick” labels are not acceptable. Sheet lifters shall be supplied at the front of each notebook. Size notebooks a minimum of 1/2 inch thicker than the material for future inserts. Label the spine and front cover of each notebook. If more than one notebook is required, label in consecutive order. For example; 1 of 2, 2 of 2. No other forms of binding will be acceptable.

2. Prepare binder covers (front and spine) with printed title “Operation and Maintenance Instructions,” title of project, and subject matter of binder when multiple binders are required.

3. Title page with project title, Architect, Engineer, Contractor, and Subcontractor with addresses, telephone numbers, and contacts.

4. Table of Contents describing all index tabs.

5. Listing of all Subcontractors and major equipment suppliers with addresses, telephone numbers and contacts.

6. Index tabs dividing information by specification section, major equipment, or systems. All tab titles shall be clearly printed under reinforced plastic tabs. Label all equipment to match the identification in the construction documents.


8. Copies of all final approved shop drawings and submittals. Copy of power system study and overcurrent protective device settings.

9. Copies of all factory inspections and or equipment start-up reports.
10. Schematic wiring diagrams of the equipment that have been updated for field conditions. Field wiring shall have label numbers to match drawings.
11. Dimensional drawings of equipment.
12. Detailed parts lists, each with a list of suppliers.
13. Operating procedures for each system.
14. Maintenance schedule and procedures. Include a chart listing maintenance requirements and frequency.
15. Repair procedures for major components.
16. Replacement parts and service material requirements for each system and the frequency of service required.
17. Instruction books, cards, and manuals furnished with the equipment.

E. Operation and maintenance data shall consist of written instructions for the care, maintenance, and operation of the equipment and systems. Instruction books, cards, manuals furnished with the equipment shall be included.

F. In addition to the information required by Division 01 for Maintenance Data, include the following information:

1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of all replaceable parts.
2. Manufacturer's printed operating procedures to include start-up, break-in, routine and normal operating instructions, regulation, control, stopping, shut-down, and emergency instructions; and summer and winter operating instructions.
3. Maintenance procedures for routine preventive maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
4. Servicing instructions and lubrication charts and schedules.

G. Adequately instruct the Owner's designated representative in the maintenance, care, and operation of the complete systems installed under this contract.

H. Provide verbal and written instructions to the Owner's representatives by factory personnel in the care, maintenance and operation of the equipment and systems.

I. Contractor shall make DVD format compact disc of the instructions to the Owner while explaining the system so additional personnel may view the instructions at a later date. The video shall become the property of the Owner.

J. The instructions shall include:

1. Maintenance of equipment.
2. Start-up procedures for all major equipment.
3. Description of emergency system operation.

K. Notify the Architect or Engineer of the time and place for the verbal instructions to the Owner's representative so his representative can be present if desired.

L. Minimum hours of instruction time for each item and/or system shall be as indicted in each individual specification section.

M. Operating Instructions:
1. The Contractor is responsible for all instructions to the Owner’s representatives for the electrical and specialized systems.

2. If the Contractor does not have staff that can adequately provide the required instructions, he shall include in his bid an adequate amount to reimburse the owner for the Engineer to perform these services.

3.23 RECORD DOCUMENTS

A. Prepare record documents in accordance with the requirements in Division 01 Section "Closeout Procedures." In addition to the requirements specified in Division 01, indicate installed conditions for:

1. Major raceway systems, size and location, for both exterior and interior; locations of control devices; distribution and branch electrical circuitry; and fuse and circuit breaker size and arrangements.

2. Equipment locations (exposed and concealed), dimensioned from prominent building lines.

3. Approved substitutions, Contract modifications, and actual equipment and materials installed.

4. Mark Drawings to indicate revisions to conduit size and location both exterior and interior; actual equipment locations, dimensioned from column lines; concealed equipment, dimensioned to column lines; distribution and branch electrical circuitry; fuse and circuit breaker size and arrangements; support and hanger details; Change Orders; concealed control system devices.

5. Mark Specifications to indicate approved substitutions, change orders, actual equipment and materials used.

B. Maintain at the job site a separate and complete set of electrical drawings and specifications with all changes made to the systems clearly and permanently marked in complete detail.

C. Mark Drawings to indicate revisions to conduit size and location both exterior and interior; actual equipment locations, dimensioned from column lines; concealed equipment, dimensioned to column lines; distribution and branch electrical circuitry; fuse and circuit breaker size and arrangements; support and hanger details; Change Orders; concealed control system devices.

D. Mark drawings and specifications to indicate approved substitutions; Change Orders, and actual equipment and materials used. All Change Orders, RFI responses, clarifications, and other supplemental instructions shall be marked on the documents. Record documents that merely reference the existence of the above items are not acceptable. Should this Contractor fail to complete record documents as required by this contract, this Contractor shall reimburse the Architect or Engineer for all costs to develop record documents that comply with this requirement. Reimbursement shall be made at the Architect or Engineer’s hourly rates in effect at the time of the work.

E. Record changes daily and keep the marked drawings available for the Architect or Engineer’s examination at any normal work time.

F. Upon completing the job, and before final payment is made, give the marked-up drawings to the Architect or Engineer.

3.24 PROJECT CLOSEOUT

A. The following paragraphs supplement the requirements of Division 01:
B. Final Jobsite Observation:

1. The Contractor shall certify that the project jobsite is ready for the final jobsite observation.
2. If the project jobsite is not ready for final observation and additional trips are required by the Engineering team for review of final conditions, the Contractor shall reimburse the additional time and expenses to the Engineer by reduction in Contractor's final payment.
3. The Engineer shall be notified a minimum of 48 hours (two typical working days) prior to installation of ceiling tiles or lay-in ceilings to allow the Engineer to visit the project site.

C. Submit the following documents to the Architect or Engineer prior to requesting final payment:

1. Operation and maintenance manuals with copies of approved shop drawings.
2. Record documents including electronic AutoCAD/REVIT drawings and specifications.
3. Documentation of completion of all required training of Owner's personnel.
4. Provide spare parts, maintenance and extra materials in quantities specified in individual specification sections.
5. Inspection and testing reports.
6. Start-up reports on all equipment requiring a factory installation or start-up.

END OF SECTION
SECTION 26 05 19 - 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. Conductors and Cables.
   2. Remote Control and Signal Cable.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

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 “National Electrical Code.”
   1. Conform to applicable codes and regulations regarding toxicity of combustion products of insulating materials.

C. UL Compliance: Provide components which are listed and labeled by Underwriters Laboratories under the following standards.
   1. UL Std. 83 Thermoplastic-Insulated Wires and Cables.
   2. UL Std. 486A Wire Connectors and Soldering Lugs for Use with Copper Conductors.

D. NEMA and ICEA Compliance: Provide components which comply with the following standards:
   1. WC-70: Power Cables Rated 2,000V or Less for the Distribution of Electrical Energy.

E. IEEE Compliance: Provide components which comply with the following standard.
   1. Std. 82: Test procedures for Impulse Voltage Tests on Insulated Conductors.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. 

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B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Encore Wire Corp.
2. General Cable Corporation.
3. Republic Wire, Inc.

C. Copper Conductors: Comply with NEMA WC 70.

D. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN and SO.

E. Multiconductor Cable: Comply with NEMA WC 70 for Type SO with ground wire.

2.2 CONDUCTORS AND CABLES

A. General: Provide wire and cable suitable for the temperature, conditions and location where installed.

B. Feeders: Copper, THWN 600 volt insulation. stranded for No. 8 and larger.

C. Branch Circuits: Copper, THHN/THWN 600 volt insulation. Solid for No. 12 AWG, stranded for No. 10 AWG and larger.

D. Control Circuits: Copper, stranded conductor, 600 volt insulation.

E. Wire for the following specialized systems shall be as shown on drawings or as dictated within these specifications. Where not designated, the systems manufacturer's recommendations shall be adhered to for the following systems:

1. Fire Alarm.
2. Low Voltage Switching.
4. Electronic Control.
5. Data.
6. Telephone.
8. TV.

2.3 REMOTE CONTROL AND SIGNAL CABLE

A. Control Cable for Class 1 Remote Control and Signal Circuits: Copper conductor, 600 volt insulation, rated 60 degrees C, individual conductors twisted together, shielded, and covered with a PVC jacket.

B. Control Cable for Class 2 or Class 3 Remote Control and Signal Circuits: Copper conductor, 300 volt insulation, rated 60 degrees C, individual conductors twisted together, shielded, and covered with a PVC jacket; UL listed.

C. Plenum Cable for Class 2 or Class 3 Remote Control and Signal Circuits: Copper conductor, 300 volt insulation, rated 60 degrees C, individual conductors twisted together, shielded and covered with a nonmetallic jacket; UL listed for use in air handling ducts, hollow spaces used as ducts, and plenums.
2.4 CONNECTORS AND SPLICES

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. AFC Cable Systems, Inc.
   3. O-Z/Gedney; EGS Electrical Group LLC.
   4. 3M; Electrical Products Division.
   5. Tyco Electronics Corp.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type and class for application and service required.

PART 3 - EXECUTION

3.1 CONDUCTOR INSULATION, APPLICATIONS AND WIRING METHODS

A. Feeders: Type THWN, single conductors in raceway.

B. Branch Circuits: THHN-THWN, single conductors in raceway.

C. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, and strain relief device at terminations to suit application.

D. Class 1 Control Circuits: Install per NEC Article 725.

E. Class 2 Control Circuits: Install per NEC Article 725.

3.2 DEVIATION FROM CONTRACT DRAWINGS

A. Basis of Design is copper conductors installed in raceway, based on 30 degrees C ambient temperature (NEC Table 310.15(B)(16).

B. Routing multiple conductors within a single conduit requires the conductor ampacity to be derated per National Electrical Code Article 310. Do not provide more than 4 conductors within a single conduit to serve loads such as panelboards, motor control centers, motors over 1/4 horsepower, etc.

C. Underground duct conductor ampacity is based on table B.310.15(B)(2)(7) of the National Electrical code, or has been calculated in accordance with Informative Annex B: Application Information for Ampacity Calculation. Deviation from the contract documents in regards to conductor and conduit quantities or orientation as suggested by the Contractor shall require supporting calculations and a sketch for Engineer approval.

D. Where ungrounded conductors are increased in size for any reason, equipment grounding conductors shall be increased in size proportionally according to the circular mil area of the ungrounded conductors.

3.3 INSTALLTION OF CONDUCTORS AND CABLES

A. Install products in accordance with manufacturer's instructions.
B. Conceal cables in finished walls, ceilings and floors unless otherwise indicated.

C. Completely and thoroughly swab raceway before installing wire.

D. 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.

E. Use pulling means including fish tape, cable, rope, and basket weave wire and cable grips which will not damage cables or raceways. Do not use rope hitches for pulling attachment to wire or cable. Do not exceed maximum tensile strength of conductor or grip. Do not exceed maximum sidewall pressure limitations of cables.

F. Pull conductors simultaneously where more than one is being installed in the same raceway.

G. Feeder conductors shall be continuous and shall not contain splices.

H. Provide adequate length of conductors within electrical enclosures and train the conductors to terminal points with no excess. Bundle multiple conductors, with conductors larger than Number 10 AWG cabled in individual circuits. Make terminations so there is no more than 1/8 inch of exposed bare conductor at the terminal. Observe NEC 310.15 (B)(2)(a) adjustment factors.

I. Verify that interior of building has been protected from weather and mechanical work likely to damage wire and cable has been completed prior to installing wire and cable.

J. Use conductor not smaller than Number 12 AWG for power and lighting circuits.

K. Single conductors used for control circuits shall not be smaller than Number 14 AWG.

L. Use Number 10 AWG conductors (phase, neutral and ground) for 20 ampere, 120 volt branch circuits longer than 75 feet, unless drawings requirements are more stringent.

M. Use Number 10 AWG conductors (phase, neutral and ground) for 20 ampere, 277 volt branch circuits longer than 200 feet, unless drawings requirements are more stringent.

N. Use Number 8 AWG conductors (phase, neutral and ground) or larger for outdoor lighting circuits.

O. Place an equal number of conductors for each phase, neutral and ground of a circuit within the same raceway or cable when routing parallel conductors. Conductor lengths must be equal.

P. Support cables according to Division 26 Section "Hangers and Supports."

Q. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

3.4 CONNECTIONS AND TERMINATIONS

A. Tighten electrical connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values. Where manufacturer's torquing
requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A.

B. Clean conductor surfaces before installing lugs and connectors.

C. Utilize solderless compression terminals applied with circumferential compression for conductor sizes 8 AWG and larger and crimp in accordance with manufacturer instructions. Indenter compression method may be used for conductor sizes 10 AWG and smaller.

D. Phase Sequence: Connections to phase conductors at electrical equipment shall be made such that the A-B-C conductors, when facing the equipment, are oriented top to bottom, or left to right.

E. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

3.5 SPLICES AND TAPS

A. Conductor splices shall be kept to a minimum.

B. Only splice within accessible junction boxes or enclosures.

C. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors. Splices and taps shall be capable of carrying the full ampacity of the conductors without perceptible temperature rise.

D. Above Grade:
   1. Use copper compression connectors applied with circumferential compression for conductor sizes 6 AWG and larger.
   2. Use pre-molded insulated tap connectors for copper conductor splices and taps, Number 8 AWG and smaller. Insulate with UL listed insulating cover supplied by same manufacturer as connector.
   3. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, Number 10 AWG and smaller.
   4. Tape uninsulated conductors and connectors with electrical tape to 150 percent of insulation rating of conductor, or three layers of tape, whichever is greater.

E. Below Grade:
   1. Use specified insulated connectors suitable and approved for below grade wiring connectors. Ensure that conductors do not apply tension to splice.
3.6 FIELD QUALITY CONTROL

A. Inspect wire for physical damage and proper connection.

B. Measure tightness of bolted connections with properly scaled and calibrated torque tool and compare torque measurements with manufacturer's recommended values.

C. Before energizing, test wires and cables for electrical continuity and for short circuits.

D. Remove and replace malfunctioning conductors and retest as specified above.

END OF SECTION
SECTION 26 05 26 - GROUNDING AND BONDING

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 solid grounding of electrical systems and equipment. It includes basic requirements for grounding for protection of life, equipment, circuits and systems. Grounding requirements specified in this Section may be supplemented in other sections of these Specifications.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer product information for each type of product indicated to be provided.

B. Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:

1. Ground rods.

C. Field Test Reports: Submit written test reports to include the following:

1. Test procedures used.
2. Weather and soil conditions observed on test date.
3. Test results that comply with requirements.
4. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

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 UL 467 for grounding and bonding materials and equipment.

C. Listing and Labeling: Provide products specified in this Section that are listed and labeled for the specific purposes by Underwriters Laboratories.

D. Testing Agency Qualifications: Member Company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING PRODUCTS
   A. Products: Of types indicated and of sizes and ratings to comply with NEC. Where types, sizes, ratings and quantities indicated are in excess of NEC requirements, the more stringent requirements and the greater size, rating, and quantity indications govern.

2.2 CONDUCTORS
   A. General: Comply with Division 26 Section "Conductors and Cables" for insulated grounding conductors. Conform to NEC Table 8, except as otherwise indicated, for conductor properties, including stranding.
   B. Equipment Grounding Conductor: Green insulated for 208/120V, Green with yellow trace insulated for 480/277V. Conductor metal shall match branch circuit conductor metal.
   C. Grounding Electrode Conductor: Stranded cable.
   D. Underground Conductors: Bare, stranded copper except as otherwise indicated.
   E. Copper Conductors: Conform to the following:
      1. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
      2. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
      3. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
      4. Bonding Strap Conductor/Connectors: Soft copper, 0.05 inch thick and 2 inches wide, except as indicated.

2.3 GROUNDING BUS
   A. Predrilled rectangular bars of annealed copper, 1/4-inch by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

2.4 CONNECTORS
   A. Listed and labeled by an NRTL 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, pressure (clamp) type with at least two bolts.
   C. Bus-bar Connectors: Mechanical type, cast silicon bronze, solderless compression type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
   D. Pressure Connectors: High-conductivity-plated units.
   E. Bolted Clamps: Heavy-duty units listed for the application.
2.5 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel.
   1. Size: 3/4 inch diameter by 10 feet length.

PART 3 - EXECUTION

3.1 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.

B. Route grounding electrode conductors within rigid polyvinyl chloride (PVC) conduit.

C. Seal all exterior wall penetrations air-tight.

3.2 GROUNDING ELECTRODES

A. Ground Rods: Provide a minimum of two ground rods separated no less than 20 feet from each other.
   1. Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.
   2. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any. Utilize exothermic welds where ground rods are not provided within test wells.

B. Grounding and Bonding for Piping:
   1. Metal Water/Fire Protection Service Pipe: Install insulated copper grounding conductors in conduit from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
   2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.

3.3 GROUNDING BUS

A. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment and elsewhere as indicated.
3.4 EQUIPMENT GROUNDING CONDUCTOR

A. Equipment Grounding Conductor Application: Comply with NEC Article 250 for sizes and quantities of equipment grounding conductors, except where larger sizes or more conductors are indicated.

B. Install separate insulated equipment grounding conductors with all feeders and branch circuit conductors. Terminate each end on a grounding lug or bus.

3.5 BONDING

A. Air Duct Equipment Circuits: Install an insulated equipment grounding conductor to duct-mounted electrical devices operating at 120-V and above including air cleaners and heaters. Bond the conductor to each such unit and to the air duct.

B. Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, pumps, blowers, electric heaters and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

C. Water Heater, Heat Tracing, and Anti-Frost Heater Circuits: Install separate insulated equipment ground conductor to each electric water heater, heat tracing and surface anti-frost heating cable. Bond this conductor to heater units, piping and connected equipment and components.

D. Building Expansion Joints: Provide flexible bonding jumper between columns and beams on both sides of each expansion joint.

E. Separately Derived Systems: Where the NEC requires separately derived systems to be grounded, provide grounding in accordance with the NEC.

F. Connection to Other Systems: Bond electrical system grounding, telephone, CATV, other communications systems, metal water piping, and other piping systems together.

G. Signal and Communication Equipment: In addition to grounding and bonding required by NFPA 70, provide a separate grounding system complying with requirements in TIA/ATIS J-STD-607-A.

1. For telephone, alarm, voice and data and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet and central equipment location.

2. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-inch by-4-inch by-12-inch grounding bus.

3. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

H. Metal Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.
1. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

J. Braided-Type Bonding Jumpers: Install to connect ground clamps on water meter piping to bypass water meters electrically. Use elsewhere for flexible bonding and grounding connections.

3.6 CONNECTIONS

A. General: Select connectors, hardware and conductors and make connections in such a manner as to minimize possibility of galvanic action or electrolysis.

1. Make connections with clean bare metal at points of contact.
2. Coat and seal connections involving dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
3. Exothermic Welded Connections or Compression-type Connections: Use for connections to structural steel and for underground connections except those at test wells. Install at connections to ground rods and plate electrodes. Comply with manufacturer's written recommendations. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable. Compression connections should be inspected for visible die index number matching the die and connector used. Connections that do not show this are not acceptable.

B. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Exothermic-welded or compression-type connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Exothermic-welded or compression-type ground stud connector.

C. Equipment Grounding Conductors: Terminate insulated equipment grounding conductors for feeders and branch circuits with pressure-type grounding lugs.

D. Metallic Raceway Continuity: Where metallic raceways terminate at metallic housings without mechanical and electrical connection to the housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to the ground bus in the housing. Bond electrically non-continuous conduits at both entrances and exits with grounding bushings and bare grounding conductors.

E. Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torquing requirements are not indicated, tighten connections to comply with torque tightening values specified in UL 486A.
F. Compression-Type Connections: Use hydraulic compression tools of at least 14-ton size to provide the correct circumferential pressure for compression connectors. Use tools and dies recommended by the manufacturer of the connectors. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on the ground conductor.

3.7 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.

B. Underground Grounding Conductors: Install bare copper conductor, No. 3/0 AWG minimum.
   1. Bury at least 24 inches below grade.
   2. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.

C. Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.

D. Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders and cable shields within each manhole or handhole to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

E. Grounding System: Ground non-current-carrying metallic items associated with manholes, substations, and pad-mounted equipment by connecting them to bare underground cable and grounding electrodes arranged as indicated.

3.8 FIELD QUALITY CONTROL

A. Independent Testing Organization: Contractor shall arrange and pay for the services of a qualified independent electrical testing organization to perform tests described below.

B. Tests and Inspections: After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements:
   1. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
   2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal at individual ground rods. Make tests at ground rods before any conductors are connected.
      a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than
natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.

b. Perform tests by fall-of-potential method according to IEEE 81.

3. Prepare dimensioned drawings locating each ground rod and ground-rod assembly and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

4. Maximum Ground Resistance Values:
   a. Service neutral to reference ground: 5 Ohms
   b. Equipment rated 500 kVA and Less: 10 Ohms.
   c. Equipment rated 500 to 1000 kVA: 5 Ohms.
   d. Manhole Grounds: 10 Ohms.

5. Where resistance to ground exceeds specified values, notify Engineer and include recommendations to reduce ground resistance.

3.9 SURFACE RESTORATION

A. Restore surface features at areas disturbed by excavation and reestablish original grades except as otherwise indicated. Where sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other Work to their original condition. Include necessary topsoil, fertilizing, liming, seeding, sodding, sprigging or mulching. Perform such Work in accordance with Division 32. Maintain disturbed surfaces. Restore vegetation in accordance with the requirements of that Division. Restore disturbed paving as indicated.

END OF SECTION
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. Secure support from the building structure for electrical items by means of hangers, supports, anchors, sleeves, inserts, seals and associated fastenings.
2. Construction requirements for concrete bases.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.
B. IMC: Intermediate metal conduit.
C. RMC: Rigid metal conduit.
D. 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 four times the applied force.

1.4 SUBMITTALS

A. Submittals for approval by the Engineer are not required for this section. Unrequested submittals will not be processed or reviewed. Non-request of submittals is not to be construed as an allowance for substitutions and does not relieve the contractor from full compliance with the plans and specifications.

1.5 QUALITY ASSURANCE

A. Comply with NFPA 70.
B. Electrical components shall be listed and labeled for the specific intended purpose by Underwriters Laboratories, Inc.
C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.6 COORDINATION

A. Coordinate size, shape 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 MANUFACTURERS

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

1. Slotted Metal Angle and U-Channel Systems:
   a. Allied Tube & Conduit.
   c. B-Line Systems, Inc.
   d. GS Metals Corp.
   e. Unistrut Diversified Products.

2. Conduit Sealing Bushings:
   a. Bridgeport Fittings, Inc.
   c. O-Z/Gedney.
   d. Raco, Inc.
   e. Red Seal Electric Corp.

2.2 COATINGS

A. Coating: Supports, support hardware, and fasteners shall be protected with zinc coating or with treatment of equivalent corrosion resistance using approved alternative treatment, finish or inherent material characteristic.

2.3 MANUFACTURED SUPPORTING DEVICES

A. Raceway Supports: Clevis hangers, riser clamps, conduit straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets and spring steel clamps.

B. Fasteners: Types, materials and construction features as follows:

1. Expansion Anchors: Carbon steel wedge or sleeve type.
2. Toggle Bolts: All steel springhead type.

C. Conduit Sealing Bushings: Factory-fabricated watertight conduit sealing bushing assemblies suitable for sealing around conduit or tubing passing through concrete floors and walls. Construct seals with steel sleeve, malleable iron body, neoprene sealing grommets or rings, metal pressure rings, pressure clamps and cap screws.

D. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for non-armored electrical cables in riser conduits. Provide plugs with number and size of conductor gripping holes as required to suit individual risers. Construct body of malleable-iron casting with hot-dip galvanized finish.

E. U-Channel Systems: 16-gauge steel channels, with 9/16-inch-diameter holes, between one and one half and two and one half inches on center, in top surface. Provide fittings and accessories that mate and match with U-channel and are of the same manufacture.
2.4 FABRICATED SUPPORTING DEVICES

A. General: Shop- or field-fabricated supports or manufactured supports assembled from U-channel components.

B. Steel Brackets: Fabricated of angles, channels and other standard structural shapes. Connect with welds and machine bolts to form rigid supports.

C. Pipe Sleeves:

1. Provide pipe sleeves of one of the following:
   a. Interior Dry Locations: Fabricate from Schedule 40 galvanized steel pipe or Schedule 40 PVC plastic pipe.
   b. Exterior or Interior Wet or Damp Locations: Fabricate from Schedule 40 PVC plastic pipe.

2. Sleeves shall not penetrate structural members without approval from the Structural Engineer.

3. Openings through unexcavated floors and/or foundation walls below the floor shall have a smooth finish with sufficient annular space around material passing through opening so slight settling will not place stress on the material or building structure.

4. Install all sleeves concentric with conduits. Secure sleeves in concrete to wood forms. This Contractor is responsible for sleeves dislodged or moved when pouring concrete.

5. Where conduits rise through concrete floors that are on earthen grade, provide 3/4-inch resilient expansion joint material (asphalt and cork) wrapped around the pipe, the full depth of concrete at the point of penetration. Secure to prevent shifting during concrete placement and finishing.

6. Size sleeves large enough to allow expansion and contraction movement.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install supporting devices to fasten electrical components securely and permanently in accordance with NEC requirements.

B. Coordinate with the building structural system and with other disciplines’ installations.

C. Raceway Supports: Comply with the NEC and the following requirements:

1. Conform to manufacturer's recommendations for selection and installation of supports.

2. Strength of each support shall be adequate to carry present and future load multiplied by a safety factor of at least four. Where this determination results in a safety allowance of less than 200 lbs, provide additional strength until there is a minimum of 200 pounds safety allowance in the strength of each support.

3. Install individual and multiple (trapeze) raceway hangers and riser clamps as necessary to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.

4. Support parallel runs of horizontal raceways together on trapeze-type hangers.
5. Support individual horizontal raceways by separate pipe hangers. Spring steel fasteners may be used in lieu of hangers only for 1-inch and smaller raceways serving branch circuits, telephone and data above suspended ceilings only. For hanger rods with spring steel fasteners, use 1/4-inch-diameter or larger threaded steel. Use spring steel fasteners that are specifically designed for supporting single conduits or tubing.

6. Space supports for raceways in accordance with Table I of this section. Space supports for raceway types not covered by the above in accordance with NEC.

7. Support exposed and concealed raceway within 3 feet of boxes, access fittings, device boxes or cabinets.

8. In vertical runs, arrange support so the load produced by the weight of the raceway and the enclosed conductors is carried entirely by the conduit supports with no weight load on raceway or conductor terminals.


10. Miscellaneous Supports: Support miscellaneous electrical components as required to produce the same structural safety factors as specified for raceway supports. Install metal channel racks for mounting cabinets, panelboards, disconnects, control enclosures, pull boxes, junction boxes, transformers and other devices.

D. Fastening: Unless otherwise indicated, fasten electrical items and their supporting hardware securely to the building structure, including but not limited to conduits, raceways, cables, cable trays, busways, cabinets, panelboards, transformers, boxes, motor control centers, disconnect switches and control components in accordance with the following:

1. Fasten by means of wood screws or screw-type nails on wood, toggle bolts on hollow masonry units, concrete inserts or expansion bolts on concrete or solid masonry, and machine screws, welded threaded studs, or spring-tension clamps on steel. Do not weld conduit, pipe straps, or items other than threaded studs to steel structures. In partitions of light steel construction, use sheet metal screws.

2. Holes cut to depth of more than 1-1/2 inches in reinforced concrete beams or to depth of more than 3/4-inch in concrete shall not cut the main reinforcing bars. Fill holes that are not used.

3. Do not fasten supports to ceiling systems, piping, ductwork, mechanical equipment or conduit unless otherwise noted.

4. Do not use powder-actuated anchors without specific permission.

5. Do not drill structural steel members.

6. Install surface-mounted cabinets and panelboards with minimum of four anchors.

7. Bridge studs top and bottom with channels to support flush-mounted cabinets and panelboards in stud walls.

E. In wet locations and on all building floors below exterior earth grade install freestanding electrical equipment on concrete pads.

F. Ensure that the load applied to any fastener does not exceed 25 percent of the proof test load. Use vibration- and shock-resistant fasteners for attachments to concrete slabs.

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions and directions furnished with items to be embedded.

2. Install anchor bolts to elevations required for proper attachment to supported equipment.

3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
### 3.2 PAINTING

A. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

#### TABLE I: SPACING FOR RACEWAY SUPPORTS

<table>
<thead>
<tr>
<th>Raceway Size (Inches)</th>
<th>No. of Conduits in Run</th>
<th>Location</th>
<th>Maximum Spacing of Supports (Feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>RMC &amp; IMC*</td>
</tr>
</tbody>
</table>

##### HORIZONTAL RUNS

<table>
<thead>
<tr>
<th>Raceway Size (Inches)</th>
<th>No. of Conduits in Run</th>
<th>Location</th>
<th>Maximum Spacing of Supports (Feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2, 3/4</td>
<td>1 or 2</td>
<td>Flat ceiling or wall.</td>
<td>5</td>
</tr>
<tr>
<td>1/2, 3/4</td>
<td>1 or 2</td>
<td>Where it is difficult to provide supports except at intervals fixed by the building construction.</td>
<td>7</td>
</tr>
<tr>
<td>1/2, 3/4, 1</td>
<td>3 or more</td>
<td>Any location.</td>
<td>7</td>
</tr>
<tr>
<td>1 &amp; larger</td>
<td>1 or 2</td>
<td>Flat ceiling or wall.</td>
<td>6</td>
</tr>
<tr>
<td>1 &amp; larger</td>
<td>1 or 2</td>
<td>Where it is difficult to provide supports except at intervals fixed by the building construction.</td>
<td>10</td>
</tr>
<tr>
<td>1 &amp; larger</td>
<td>3 or more</td>
<td>Any location.</td>
<td>10</td>
</tr>
<tr>
<td>Any</td>
<td>--</td>
<td>Concealed.</td>
<td>10</td>
</tr>
</tbody>
</table>

##### VERTICAL RUNS

<table>
<thead>
<tr>
<th>Raceway Size (Inches)</th>
<th>No. of Conduits in Run</th>
<th>Location</th>
<th>Maximum Spacing of Supports (Feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2, 3/4</td>
<td>--</td>
<td>Exposed.</td>
<td>7</td>
</tr>
<tr>
<td>1, 1-1/4</td>
<td>--</td>
<td>Exposed.</td>
<td>8</td>
</tr>
<tr>
<td>1-1/2 and larger</td>
<td>--</td>
<td>Exposed.</td>
<td>10</td>
</tr>
<tr>
<td>Up to 2</td>
<td>--</td>
<td>Shaftway.</td>
<td>14</td>
</tr>
<tr>
<td>2-1/2</td>
<td>--</td>
<td>Shaftway.</td>
<td>16</td>
</tr>
<tr>
<td>3 &amp; larger</td>
<td>--</td>
<td>Shaftway.</td>
<td>20</td>
</tr>
<tr>
<td>Any</td>
<td>--</td>
<td>Concealed.</td>
<td>10</td>
</tr>
</tbody>
</table>

*Maximum spacings for IMC above apply to straight runs only. Otherwise the maximums for EMT apply.

END OF SECTION
SECTION 26 05 33 - RACEWAYS

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 raceways electrical wiring:

1. Metallic Conduit and Tubing.
3. Metal Wireways.
4. Surface Raceways.
5. Low Voltage Cabling Support.
6. Communications Raceway Accessories.

B. Related Sections include the following:

1. Division 26 Section "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.
B. EPDM: Ethylene-propylene-diene terpolymer rubber.
C. FMC: Flexible metal conduit.
D. IMC: Intermediate metal conduit.
E. LFMC: Liquidtight flexible metal conduit.
F. NBR: Acrylonitrile-butadiene rubber.
G. RMC: Rigid metallic conduit.
H. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

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.

05/11/2015

26 05 33 - 1
B. Comply with NFPA 70 "National Electrical Code" for components and installation.

C. Comply with NECA "Standard of Installation."

D. Listing and Labeling: Provide products specified in this Section that are listed and labeled by Underwriters Laboratories for the specific purpose and comply with the following standards:

1. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
2. ANSI C80.3 - Electrical Metallic Tubing, Zinc Coated.
3. ANSI/NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
4. ANSI C80.6 – Intermediate Metal Conduit, Zinc Coated.
5. ANSI/NFPA 70 - National Electrical Code.
6. ANSI/NEMA FB 1 – Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable.
7. NECA "Standard of Installation."
8. NEMA TC 2 - Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).
9. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.
10. NEMA TC 6 - PVC and ABS Plastic Utilities Duct for Underground Installation.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Provide conduit, tubing and fittings of types, grades, sizes and weights (wall thicknesses) for each service indicated. Where types and grades are not indicated, provide proper selection determined by installer to fulfill wiring requirements, and comply with applicable portions of NFPA 70 for raceways.

B. Bushings: Bushings for terminating conduits smaller than 1-1/4 inches are to have flared bottom and ribbed sides, with smooth upper edges to prevent injury to cable insulation. Install insulated type bushings for terminating conduits 1-1/4 inches and larger. Upper edge to have phenolic insulating ring molded into bushing. Bushings to have screw type grounding terminal.

C. Raintight Sealing Hubs: Two piece type with outer internally-threaded hub to receive conduit, inner locking ring with bonding screw, insulated throat, and V-shaped ring or O-ring.

2.2 METAL CONDUIT AND TUBING

A. Rigid Steel (Metallic) Conduit:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Allied Tube & Conduit.
b. LTV Steel Tubular Products Company.
c. O-Z Gedney.
d. Wheatland Tube Company.

2. Description: Conduit to be seamless, hot dipped galvanized rigid steel. Threads to be cut and ends chamfered prior to galvanizing. Galvanizing to provide zinc coating fused to inside and outside walls of conduit. Provide an enamel lubricating coating on the inside of the conduit. Conduit to conform to ANSI C80.1 and listed and labeled under UL 6.

3. Fittings and Conduit Bodies: NEMA FB 1, single piece threaded, cadmium plated malleable iron.

4. Joint Compound: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

B. Intermediate Metal Conduit:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Allied Tube & Conduit.
   b. LTV Steel Tubular Products Company.
   c. O-Z Gedney.
   d. Wheatland Tube Company.

2. Description: Conduit to be seamless, hot dipped galvanized rigid steel. Threads to be cut and ends chamfered prior to galvanizing. Galvanizing to provide zinc coating fused to outside walls of conduit. Provide an enamel lubricating coating on the inside of the conduit. Conduit to be listed and labeled under UL 1242.

3. Fittings and Conduit Bodies: NEMA FB 1, single piece threaded, cadmium plated malleable iron.

4. Joint Compound: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

C. Electrical Metallic Tubing:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Allied Tube & Conduit.
   b. LTV Steel Tubular Products Company.
   c. O-Z Gedney.
   d. Wheatland Tube Company.

2. Description: Conduit to be seamless, hot dipped or electro-galvanized steel tubing. Galvanizing to provide zinc coating fused to outside walls of conduit. Provide an enamel lubricating coating on the inside of the conduit. Conduit to conform to ANSI C80.3 - 1983 and listed and labeled under UL 797.

3. Fittings and Conduit Bodies: Steel Compression for 2" trade size and smaller. Steel set screw for 2 ½" trade size and larger.

4. Expansion fittings for use with EMT shall allow for a minimum of four inches of movement and shall be similar to O-Z Gedney TX series, complete with bonding jumpers and hardware.
D. Flexible Metal Conduit: Zinc-coated steel or aluminum.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. AFC Cable Systems.
   b. Alflex Inc.
   c. Electri-Flex Co.

2. Description: Interlocked steel or aluminum construction, consisting of spirally wrapped, convoluted hot dip galvanized steel strip. Zinc coating to cover both sides and all edges of steel strip. Convolutions to be interlocked to prevent separation when conduit is bent at radius equal to 4-1/2 times conduit O.D. Conduit to be listed and labeled under UL 1.


E. Liquidtight Flexible Metal Conduit:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. AFC Cable Systems.
   b. Alflex Inc.
   c. Electri-Flex Co.

2. Description: Flexible steel conduit with PVC jacket, listed and labeled under UL 360.

3. Fittings: and Conduit Bodies: Watertight, compression type, galvanized zinc coated cadmium plated malleable cast iron. Conduit to be listed and labeled under UL 360.

2.3 NONMETALLIC CONDUIT AND TUBING

A. Rigid Non-Metallic Conduit:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Cantex.
   b. J.M. Manufacturing.
   c. Lamson & Sessions; Carlon Electrical Products.

2. Description: Conduit to be PVC, Schedule 40 or Schedule 80 as indicated, rated for use with 90 degrees C conductors and suited for direct burial and above ground use in direct sunlight, whether encased in concrete or not. Conduit to conform to latest edition of ASTM F512, NEMA TC-2, and be listed and labeled under UL 651.

3. Fittings and Conduit Bodies: Manufactured per NEMA TC-3 and UL 651 listed to match conduit, type and material. Expansion fittings shall allow for six inch movement, and shall be similar to Carlon E945 series. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.
2.4 METAL WIREWAYS

A. Available Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper B-Line, Inc.
2. Hoffman.
3. Square D; Schneider Electric.

B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1, 12, or 3R as environmental conditions dictate, unless otherwise indicated.

C. Material: Primed and painted sheet steel for indoor locations, galvanized sheet steel for outdoor locations sized as indicated or required, whichever is greater.

1. Wireway up to 6 inch by 6 inch cross section shall be minimum 16 gage.
2. Wireway larger than 6 inch by 6 inch cross section shall be minimum 14 gage.

D. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

E. Wireway Covers: Hinged. Utilize flanged-and-gasketed type for outdoor locations.

F. Finish: Manufacturer's standard gray enamel finish.

2.5 SURFACE RACEWAYS

A. Surface Metal Raceways: Extruded Aluminum.

1. Available Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Thomas & Betts Corporation.
   c. Wiremold Company (The); Electrical Sales Division.

2. Provide types, sizes, and channels as indicated and required for each application, with fittings that match and mate with raceway.

2.6 LOW VOLTAGE CABLING SUPPORT

A. General: The following supporting products are for use in systems below 50V.

B. Open top cable supports (J-Hooks)

1. Galvanized steel construction with smooth rounded edges.
2. Complies with UL, cUL, NEC, and ANSI/TIA/EIA requirements for structured cabling systems.
3. Manufacturers:

   a. Erico.
   b. B-Line.
   c. Panduit.
C. Small Secondary Pathways:

1. Mounting for up to ten 4 pair UTP cables may be supported from ceiling grid support wires (at least every 5 feet).
2. Manufacturers:
   a. Erico.
   b. B-Line.
   c. Panduit.

2.7 COMMUNICATIONS RACEWAY ACCESSORIES

A. Pull cords:

1. Pull wires shall be nylon type.
2. Provide in all empty conduits, sleeves, raceways and all cabling pathways for future use.
3. Pull cords shall have a tensile rating of 200 pounds minimum.

B. Fiber Optic Innerduct:

1. NEMA TC 5, UL listed, corrugated, specifically designed for optical fiber cable pathways.
2. Fiber optic innerduct shall be orange in color.
3. Innerduct shall be 1-inch minimum inside diameter, and a minimum pulling strength of 600 pounds.
4. Each innerduct shall include a factory installed pull rope.
5. Each duct shall be suited for the environment in which it is installed.
6. Manufacturers:
   a. Carlon.
   b. Arnco.
   c. Opti-Com.
   d. Maxcell.

C. Cable Spillways:

1. Provide Spillway on sleeves 2 inches and greater.
2. Manufacturers:
   a. Bejed.
   b. B-Line.
   c. Panduit.

PART 3 - EXECUTION

3.1 METALLIC AND NON-METALLIC CONDUIT APPLICATION

A. See Table Below.
<table>
<thead>
<tr>
<th>APPLICATION</th>
<th>GRC</th>
<th>IMC</th>
<th>EMT</th>
<th>FMC</th>
<th>LPMC</th>
<th>RNC 40</th>
<th>RNC 80</th>
<th>HOPE 80</th>
<th>MC FPLP</th>
<th>IU STD'S</th>
</tr>
</thead>
<tbody>
<tr>
<td>POWER FEEDER INTERIOR</td>
<td></td>
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<tr>
<td>CONCEALED 2&quot; AND LARGER OR EXPOSED</td>
<td>A2</td>
<td>a, b</td>
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<td>CONCEALED 1-1/2&quot; AND SMALLER</td>
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<td>ABOVE GRADE</td>
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**General Notes**
1) Refer to the listed sections for more details and limitations
2) The symbol * - indicates approved type

**Abbreviations**
- GRC = Galvanized Rigid Metal Conduit
- IMC = Intermediate Metal Conduit
- EMT = Electrical Metallic Tubing
- FMC = Flexible Metallic Conduit
- LPMC = Liquid Tight Flexible Metallic Conduit
- RNC 40 = Rigid Nonmetallic Conduit, Schedule 40
- RNC 80 = Rigid Nonmetallic Conduit, Schedule 80
- HOPE 80 = High Density Polyethylene, Schedule 80
- MC FPLP = Plenum rated, Type MC FPLP, with red jacket

**REV January 2014**
B. Conduit Size: Conduits shall be sized as shown on drawings. Where conduit sizes are not indicated, conduits shall be sized in accordance with the latest version of the National Electrical Code (NFPA 70) and shall be limited to a 40 percent conductor fill percentage. Conductor ampacities must be maintained; therefore adjustment factors for temperature and quantity derating values must be observed.

1. Minimum Conduit Size: Unless otherwise noted, 3/4-inch trade size with the following exceptions:


3.2 METALLIC AND NON-METALLIC CONDUIT INSTALLATION

A. General Installation Requirements

1. Conduits shall be mechanically and electrically continuous from source of current to all outlets unless a properly sized grounding conductor is routed within the conduit. All metallic conduits shall be bonded per NFPA 70.

2. Do not reduce the indicated sizes of raceways. Conduit sizes may only change between junction and pull boxes.

3. Complete raceway installation before starting conductor installation.

4. Use temporary closures to prevent foreign matter from entering raceway.

5. Avoid moisture traps; provide junction box with drain fitting at low points in raceway system.

6. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire.

7. This contractor shall be responsible for all openings required in masonry or exterior walls for conduit routing. A qualified contractor capable of repairing all openings in a manner that matches existing conditions shall be hired by the electrical contractor.

B. Conduit Routing:

1. In general, conduit shall be concealed in walls within finished spaces and may be exposed within unfinished spaces (such as mechanical and utility areas) where conditions dictate and as practical.

2. Raceway routing proposed on Drawings is diagrammatic in nature and shown in approximate locations unless dimensioned. Coordinate conduit routing with beams, joists, columns, windows, etc., as required to complete wiring system. Verify field measurements, routing and termination locations of raceway with obstructions and other trades prior to rough-in. The electrical contractor shall be responsible for any expense due to the failure of coordination between other trades to ensure fit and avoid conflict.

3. Run concealed raceways with a minimum of bends in the shortest practical distance considering the type of building construction and obstructions, except as otherwise indicated.

4. Route exposed conduit and conduits above ceilings parallel and perpendicular to building structural lines, and as close to building structure as possible.

5. Raceways are not to cross pipe shafts or ventilating duct openings, nor are they to pass through HVAC ducts. Support riser raceway at each floor level with clamp hangers. Maintain adequate clearance between raceway and piping.

6. Coordinate layout and installation of conduit with other construction elements to ensure adequate headroom, working clearance and access.
7. Route conduit through roof openings provided for piping and ductwork or rooftop unit curbs where possible. Where unavoidable, route conduit through suitable roof jack with pitch pocket. Coordinate roof penetrations with other trades.

8. 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.

9. Do not install aluminum conduits in contact with concrete.

C. Conduit Supports:

1. Install raceways level and square and at proper elevations. Provide adequate headroom. Group related conduits; support using conduit rack. Construct rack using steel channel. All conduit supports shall be secured to walls, structural members, slabs and bar joists. Do not support conduits from non-structural members, such as ductwork, water or fire suppression piping.

2. Run parallel or banked raceways together, on common support racks where practical and make bends from same center line to make bends parallel. Use factory elbows only where they can be installed parallel; otherwise, provide field bends for parallel raceways. Provide space within each rack for 20 percent additional conduits.

3. Support raceways as specified in Division 26 Section "Hangers and Supports."

D. Conduit Fittings and Terminations:

1. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

2. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

3. Install raceway sealing fittings according to the manufacturer's written instructions. Locate fittings at suitable, approved, accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank coverplate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings where conduits enter or leave hazardous locations, where conduits pass from warm locations to cold locations, such as the boundaries of refrigerated spaces, such as kitchen cold boxes, air-conditioned spaces and other places indicated on the drawings or required by NFPA 70.

4. Expansion/Deflection Joints: Provide suitable fittings to accommodate expansion and contraction where raceway crosses seismic and expansion joints. Install expansion fittings in the full open position if installed during a period of lowest expected temperature, and in the fully closed position if installed during a period of highest expected temperature. Install at proportionate intermediate position for intermediate temperatures.

   a. In addition to the foregoing, provide expansion fittings according to the following table, for exposed linear runs or runs in hung ceilings where such runs do not contain junction boxes, pull boxes, nor bends totaling more than 30 degrees.

   b. EMT and RMC expansion couplers shall be UL listed with an internal copper braided bonding jumper that meets the requirements of NEC 250.98. Fitting shall be listed as suitable for wet locations and rain water tight when installed in wet or outdoor locations.
### Raceway Material

<table>
<thead>
<tr>
<th>Raceway Material</th>
<th>Indoor, conditioned areas</th>
<th>Outdoors and non-conditioned areas</th>
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<tbody>
<tr>
<td>Steel</td>
<td>One expansion fitting in runs longer than 80 feet, additional expansion fittings every 400 feet</td>
<td>One expansion fitting in runs longer than 40 feet, additional expansion fittings every 200 feet</td>
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<tr>
<td>Aluminum</td>
<td>One expansion fitting in runs longer than 40 feet, additional expansion fittings every 200 feet</td>
<td>One expansion fitting in runs longer than 20 feet, additional expansion fittings every 100 feet</td>
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<tr>
<td>PVC</td>
<td>One expansion fitting in runs longer than 20 feet, additional expansion fittings every 100 feet</td>
<td>One expansion fitting in runs longer than 10 feet, additional expansion fittings every 50 feet</td>
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</tbody>
</table>

5. **Flexible Connections:** Use maximum of 6 feet of flexible metal conduit for recessed and semi-recessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement and for all motors. Use Liquidtight flexible metal conduit in wet or damp locations. Install separate ground conductor across flexible connections.

6. **Avoid use of dissimilar metals throughout system to eliminate possibility of electrolysis.** Where dissimilar metals are in contact, coat surfaces with corrosion inhibiting compound before assembling.

### E. Conduit Bends:

1. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.
2. Make bends and offsets so the inside diameter is not reduced. Unless otherwise indicated, keep the legs of a bend in the same plane and the straight legs of offsets parallel.
3. Use conduit bodies to make sharp changes in direction, as around beams. Use hydraulic one-shot bender when field-fabricated elbows are required for bends in metal conduit larger than 2 inch size.
4. **Stub-Up Connections:** Use type of conduit described for stub-ups from slab. Extend conduit through concrete floor for connection to freestanding equipment to a distance 6-inches above the floor. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

### F. Raceways Embedded in Slabs:

- Use maximum 1-inch conduits in slabs over 4-inches thick. Use maximum 3/4-inch in slabs 4-inches thick. Do not install any conduit in slabs under 4-inches thick. Install in middle third of the slab thickness where practical, and leave at least 1-inch concrete cover; secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement. Transition to Schedule 40 non-metallic raceway or heavy gauge rigid where rising out of slab. Space raceways laterally to prevent voids in the concrete. Avoid crossing raceways over each other.

### 3.3 Wireway Installation

A. Wireway shall be securely fastened to walls using steel channels. Mount plumb and level.

### 3.4 Surface Raceway Installation

A. Surface Metal Raceways:
1. Install surface metal raceway with all necessary offsets, fittings, bends and boxes to comprise a complete system. Provide manufacturer raceway accessories as needed. Mount plumb and level.

2. Install a separate green ground conductor in raceway from the junction box supplying the raceway to receptacle or fixture ground terminals. Maintain grounding continuity throughout surface metal raceway components.

3.5 COMMUNICATIONS RACEWAY INSTALLATION REQUIREMENTS

A. General:

1. These guidelines are intended to supplement the requirements listed in other portions of this specifications section.

2. Minimum raceway size shall be as necessary to comply with fill ratio of referenced standards, but in no case less than 1 inch.

3. Provide specified pull wires in all cabling pathways.

4. Ground and bond all systems in accordance with the NEC and ANSI/TIA/EIA 607.

5. All installation material and practices shall fully comply with NFPA 70 “National Electrical Code” and ANSI/TIA/EIA 569A Commercial Building Standard for Telecommunications Pathways and Spaces (BICSI).

6. Coordinate work with the building structural systems and electrical installation.

7. All work shall fully comply with these Specifications and related Drawings and all manufacturers' recommended installation practices.

8. Do not install conduit in concrete slab.

9. There shall not be more than the equivalent of 180 degrees of bends in any single run of conduit between adequately sized pull.

10. Conduits entering a Telecommunications room below the finished ceiling shall be extended a minimum of 4-inches below the ceiling, and shall be routed as tight to the adjacent wall as possible.

11. Conduits entering a Telecommunications room through a wall shall extend 15 inches into the room and kept a minimum of 8 feet above finished floor.

12. Conduit bends:

   a. Bends shall be made so that the conduit will not be flattened or kinked and the internal diameter of the conduit will not be reduced.

   b. The radius of the curve of the inner edge of any bend shall not be less than as indicated by the National Electrical Code and ANSI/TIA/EIA 569A Commercial Building Standard for Telecommunications Pathways and Spaces.

   c. In no case shall any conduit be bent or any fabricated elbow be applied to less than the allowable bending radius as specified by the cable manufacturer of the installed conductor.

   d. When necessary to make field bends, use tools designed for conduit bending. Heating of metallic conduit to facilitate bending is not permitted.

13. A conduit run shall not be longer than 100 feet between pull boxes for conduit runs inside a building.

14. The contractor shall not cut, burn or drill any structural member to mount electrical equipment or to facilitate tray or conduit installations without having previously received approval, in writing, from the Architect/Engineer/Consultant.

15. Mount all conduit a minimum of 3 inches above any accessible type ceiling.

16. Maintain conduit runs at least 6 inches from insulate pipes, steam lines or any other hot pipes they pass. Where the lines are not insulated, the clearances shall...
be increased until the temperature of the conduit, with no live conductors enclosed, does not rise above the ambient temperature of the installation area.

B. Communications Pathway Separation Requirements:

1. Provide separation of communications pathways to minimize the effects of electromagnetic interference (EMI) by installing pathways in the following manner:
   
a. Provide a minimum of 12 inches separation from power lines exceeding 5kV and communications pathways not concealed in metallic conduit.
   
b. Provide a minimum of 6 inches separation from power lines exceeding 5kV and communications pathways concealed properly bonded in metallic conduit.
   
c. Provide a minimum of 37 inches separation from electrical motors and transformers and communications pathways.
   
d. When power lines or cables of different signal conditions must intersect, crossing shall be made at 90 degree angle, with proper separation as outlined above.

C. Open Top Cable Supports (J-Hooks):

1. Install J-hook pathway, supporting at least every 4 feet, as straight as possible parallel and/or perpendicular to building structure.
2. Shall be mounted to building structure or suspended by threaded rod from the deck above approximately 12 inches above suspended ceiling.
3. Attachment of J-hooks must be to building structure directly or utilize a minimum of 1/4 inch all-thread rod anchored into deck above.
4. Bundle cables with Velcro cable straps per TIA 596C and at each directional change.
5. Under no condition shall there be more than 12 inches of vertical cable sag between supports.
6. Cinch-tight cable ties are prohibited for all low voltage cabling support.
7. During installation of cables thru open top cable supports, pulling tension of cables shall not exceed 25 lbs.

3.6 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

3.7 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.
3.8 CLEANING

A. Upon completion of installation of system, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches and abrasions.

3.9 MARKING AND IDENTIFICATION

A. Mark and identify conduits in accordance with Section 26 0553 “Identification for Electrical Systems.”

B. Mark and identify communications conduits in accordance with Section 27 0000 “Communications.”

3.10 RECORD DOCUMENTS

A. Accurately record actual routing of all feeder and sub-feeder conduits regardless of size and branch circuits conduits larger than 2-inches.

END OF SECTION
SECTION 26 05 53 - 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 underground systems.
2. Identification for raceways.
3. Identification for wires, cables and conductors.
4. Floor marking tape.
5. Warning labels and signs.
6. Instruction signs.
7. Equipment identification labels.
8. Miscellaneous identification products.

1.3 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

1.4 QUALITY ASSURANCE

A. Comply with the following standards:

2. NFPA 70.
4. ANSI Z535.4 for safety signs and labels.

B. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.5 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 the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. 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 MANUFACTURERS

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

2. Ideal Industries, Inc.
3. 3M.
4. Panduit Corp.
5. Seton Name Plate Co.
6. Thomas & Betts.

2.2 ELECTRICAL IDENTIFICATION PRODUCTS

A. Self-Adhesive Vinyl Labels (Raceways and Boxes): Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

B. Self-Adhesive Vinyl Tape for Banding (Raceway, Wire and Cable): Colored, heavy duty, waterproof, fade resistant; 2 inches wide.

C. Self-Adhesive Tape Markers (Wire and Cable): Vinyl or vinyl-cloth, self-adhesive, wraparound, cable and conductor markers with preprinted numbers and letters.

D. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.

E. Write-On Tags: Polyester tag, 0.015 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.

1. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

F. Snap-Around, Color-Coding Bands (Raceways and Cables): Slit, pre-tensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

G. Colored Adhesive Marking Tape (Raceways, Wires, and Cables): Self-adhesive plastic coated cloth tape similar to Brady 441XX or 442XX series.

H. Conductor Identification Products:

1. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

2. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

I. Floor Marking Tape:

1. 2-inch- (50-mm-) wide, 5-mil (0.125-mm) pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.
J. Underground Line Warning Tape:

1. Underground Line Marking Tape: Permanent, bright-colored, corrosion-resistant, continuous-printed, plastic tape compounded for direct-burial service not less than 6 inches wide by 4 mils thick. Printed legend shall be indicative of general type of underground line below. Tape shall have integral metallic facing or metallic core to allow locating buried tape with electronic detection equipment. Provide marking tape similar to Thomas & Betts NAF series.

2.3 WARNING LABELS AND SIGNS


B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door or other access to equipment unless otherwise indicated.

C. Baked-Enamel Warning Signs: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application with 1/4-inch

D. Metal-Backed, Butyrate Warning Signs: Weather-resistant, non-fading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application. Provide 1/4-inch Plasticized Card Stock Tags: Vinyl cloth with preprinted and field-printed legends to suit the application. Orange background, except as otherwise indicated, with eyelet for fastener.

E. Engraved, Plastic-Laminated Labels, Signs, and Instruction Plates: Engraving stock melamine plastic laminate, 1/16-inch minimum thick for signs up to 20 square inches, or 8 inches in length; 1/8-inch thick for larger sizes. Engraved legend in black letters on white face and punched for mechanical fasteners.

2.4 EQUIPMENT IDENTIFICATION LABELS

A. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Overlay shall provide a weatherproof and UV-resistant seal for label. Labels shall be at least 2-1/4 inches high. Where space does not permit this label size, smaller stock and lettering is permitted.

B. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with lettering and background colors as indicated. Labels shall be at least 2-1/4 inches high. Where space does not permit this label size, smaller stock and lettering is permitted.

C. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Labels shall be at least 2-1/4 inches high. Where space does not permit this label size, smaller stock and lettering is permitted.

2.5 CABLE TIES

A. Cable Ties: Fungus-inert, self-extinguishing, nylon one-piece, self-locking cable ties, 0.18-inch minimum width, 50-lb minimum tensile strength, and suitable for a minimum temperature range from minus 50 degrees F to 350 degrees F. Provide ties in specified colors when used for color-coding.
B. Identification Cable Ties: Same as "Cable Ties" above, except with integral tab of suitable size for marking requirements.

2.6 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in Division 09 painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior). Comply with maximum volatile organic compound levels imposed within Division 09.

B. Fasteners for Labels and Signs: Self-tapping, stainless steel screws or stainless steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Increase size of labels and letters to those appropriate for viewing from the floor for elevated components.

C. Lettering and Graphics: Coordinate names, abbreviations, colors and other designations used in electrical identification work with corresponding designations specified or indicated. Install numbers, lettering and colors as required by code.

D. Install identification devices in accordance with manufacturer's written instructions and requirements of NEC.

E. Clean and degrease surfaces prior to applying identification products. Apply identification to surfaces that require finish after finish work is completed. Utilize primer for metal surfaces, heavy-duty acrylic resin block filler for concrete masonry, and clear alkali-resistant alkyd binder-type sealer for concrete surfaces.

F. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

G. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or 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 (15-m) maximum intervals in straight runs, and at 25-foot (7.6-maximum intervals in congested areas.

H. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.

I. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.
J. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches overall.

3.2 LABEL COLOR CODE LEGEND

A. Provide the following color coding scheme for each label based on the power system it is identifying:

1. Normal Power: Black letters on white background.
2. Emergency Power: White letters on red background.

3.3 UNDERGROUND SERVICE IDENTIFICATION

A. Concealed Raceways, Duct Banks, More Than 600 V, within Buildings: Tape and stencil 4-inch wide black stripes on 10-inch centers over orange background that extends full length of raceway or duct and is 12 inches wide. Stencil legend "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch high black letters on 20 inch centers. Stop stripes at legends. Apply to the following finished surfaces:

1. Floor surface directly above conduits running beneath and within 12 inches of a floor that is in contact with earth or is framed above unexcavated space.
2. Wall surfaces directly external to raceways concealed within wall.
3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.

B. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication and control wiring and optical fiber cable. Install underground-line warning tape for both direct-buried cables and cables in raceway.

C. Underground Electrical Line Identification: During trench backfilling, for exterior underground power, signal and communications lines, install continuous underground line marking tape located directly above each respective line at 6 to 8 inches below finished grade.

3.4 RACEWAY IDENTIFICATION

A. Identify Raceways with Labeling: Identify conduit every 25 feet. Apply the following labels:

1. Normal Distribution System: Black lettering on White background identifying voltage of conductors.
2. Emergency Distribution System: Red lettering on White background identifying voltage of conductors
4. Temperature Controls/Building Automation: Black letters on White background “Temperature Control”.
5. Telecommunications: Black letters on White background “Telecommunications”.

B. Where conduits leave a switchboard, panelboard, motor control center, etc., identification shall be provided on each conduit indicating the load being served.
C. Contractor shall be responsible for providing the Owner with laminated, colored, typewritten legends indicating the identification color scheme. At a minimum, these legends should be installed in the main electrical room and branch electrical closets. Provide two additional legends to the Owner to use at their discretion.

D. Identification of Raceways with Labeling:

1. Raceway Labeling: Provide labeling on conduits indicating electrical distribution system contained within (e.g. Normal, Life Safety, etc.) and operating voltage level. Label size shall be as follows:

<table>
<thead>
<tr>
<th>Nominal EMT conduit size</th>
<th>Nominal RGS conduit size</th>
<th>Length of color background on label</th>
<th>Height of letters</th>
</tr>
</thead>
<tbody>
<tr>
<td>up to 1 inch</td>
<td>up to 3/4 inch</td>
<td>8 inches</td>
<td>1/2 inch</td>
</tr>
<tr>
<td>1.25 to 1.5 inches</td>
<td>1 to 1.5 inches</td>
<td>8 inches</td>
<td>3/4 inch</td>
</tr>
<tr>
<td>2 to 5 inches</td>
<td>2 to 5 inches</td>
<td>12 inches</td>
<td>1.25 inches</td>
</tr>
<tr>
<td>6 inches</td>
<td>6 inches</td>
<td>24 inches</td>
<td>2.5 inches</td>
</tr>
</tbody>
</table>

2. Raceways carrying circuits over 600V: Provide label with 3-inch (75mm) high letters on 20-inch (500mm) centers to read as follows: "DANGER CONCEALED HIGH VOLTAGE WIRING."

3.5 BOX IDENTIFICATION

A. Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage:

1. Normal Power.
2. Emergency Power.
3. Legally Required Standby Power
4. Optional Standby Power

B. At each junction, pull and connection box, identify the following: with self-adhesive vinyl labels or permanent marker (color coded) neatly hand-printed. Identification of these boxes shall be located on the inside of cover if located in finished spaces:

1. Power and lighting circuits: Indicate system voltage and identify contained circuits and panelboard serving load (e.g., “120V, PP1-1, 3, 5”).
2. Other wiring: Indicate system type and wiring description (e.g., “FIRE ALARM NAC #2”).

C. Paint box covers to correspond with system types as follows:

1. Fire Alarm: Red.

3.6 CIRCUIT IDENTIFICATION

A. Label conductors as follows:

1. Multiple Power or Lighting Circuits in the Same Enclosure: Where multiple branch circuits are terminated or spliced in a box or enclosure, label each conductor with source and circuit number.
2. Multiple Control Wiring and Communication/Signal Circuits in Same Enclosure: For control and communications signal/wiring, use wire/cable marking tape at terminations in wiring boxes, troughs and control cabinets. Use consistent letter/number conductor designations throughout on wire/cable marking tape.

3.7 CONDUCTOR COLOR CODING

A. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, panelboards, manholes, handholes, switches, etc., use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below all conductors.

   a. Color shall be factory-applied, or field-applied for sizes larger than No. 8 AWG, if Authorities Having Jurisdiction permit

      1) 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.

   b. Colors for 208/120V Circuits:

      1) Phase A: Black.
      2) Phase B: Red.
      3) Phase C: Blue.
      4) Neutral: White.
      5) Ground Bond: Green.

   c. Colors for 480/277V Circuits:

      1) Phase A: Brown.
      2) Phase B: Orange.
      3) Phase C: Yellow.
      4) Neutral: Gray.
      5) Ground Bond: Green with yellow trace.

B. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control and signal connections.

1. Identify conductors, cables and terminals in enclosures and at junctions, terminals and pull points. Identify by system and circuit designation.

2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.


C. Open Cable Identification

1. Low Voltage Cable (Less than 120V): Provide self adhesive pre-printed vinyl tape markers at 20 foot intervals to identify all cables run exposed or located above
the accessible ceilings. Indicate the associated system by using the following color coding schemes:

a. Fire Alarm: Red lettering on white background.
b. Temperature Controls: Blue lettering on white background.
c. Security System: Black lettering on white background.
d. Telephone System: White lettering on blue background.

3.8 RECEPTACLE IDENTIFICATION

A. Identification Material: Pre-printed, self-laminating vinyl labels, 3/16-inch font height. Utilize black lettering on clear background for normal power circuits and red lettering on a clear background for emergency power circuits.

B. Coverplates: Provide identification on all receptacle coverplates indicating the source panelboard and circuit number serving the device (e.g., PP1#1).

3.9 SIGNAGE

A. Install instructional sign in each electrical room including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

B. Apply warning, caution, and instruction signs and stencils as follows:

1. Install warning, caution or operating instruction signs where required by NEC, where indicated, or where reasonably required to assure safe operation and maintenance of electrical systems and of the items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment operation. Install fiberglass signs or outdoor items.

2. Emergency Operating Signs: Install engraved laminate signs with white legend on red background with minimum 3/8-inch high lettering for emergency instructions on power transfer, load shedding or other emergency operations where required by NEC or where required to assure safe operation and maintenance.

3. Arc Flash Hazard Warning: Provide signage on all electrical equipment such as switchboards, panelboards, industrial control panels, meter socket enclosures and motor control centers indicating arc flash hazard warning and advising appropriate PPE.

3.10 FLOOR TAPE

A. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

3.11 ELECTRICAL EQUIPMENT IDENTIFICATION

A. On each unit of equipment, install unique designation label that is consistent with wiring diagrams, one-line diagram, schedules and the Operation and Maintenance Manual. Each section of a multiple-section equipment lineup shall be provided with its own identification label. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets and racks of each
system. Systems include power, lighting, control, communication, signal, monitoring and alarm systems unless equipment is provided with its own identification.

B. Labeling Instructions:

1. Indoor Equipment: Provide self-adhesive, engraved, laminated acrylic or melamine label.
2. Outdoor Equipment: Provide engraved, laminated acrylic or melamine label.
3. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
4. Nameplate Data: Provide permanent operational data nameplate on each item of power operated equipment, indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances and similar essential data. Locate nameplates in an accessible location.
5. Service Disconnects: Provide permanent engraved sign with 2-1/4 inch high black lettering on white background clearly describing the location of all other service disconnecting means (including engine generator sources and central battery systems) when the building is served by more than one source of electrical power. Locate signs at each power source's disconnect means.
6. Outdoor Electrical Equipment: Provide outdoor Pictogram type sign per above specifications, with the words "DANGER - HIGH VOLTAGE Hazardous Voltage. Will shock burn, or cause death. KEEP OUT." NEMA Mr. Ouch symbol shall be included. Install at all entrances to outdoor areas and every 20 feet along area fences, with at least one sign per side of fencing. Install on doors to equipment.
7. Fusible Switches: Install fuse manufacturer-supplied labels inside the door of the fusible switch indicating the proper type and fuse required for replacement.
8. Automatically Started Equipment: Provide adhesive label reading "DANGER - WARNING THIS MACHINE IS AUTOMATICALLY CONTROLLED. IT MAY START AT ANY TIME" on all motors, generators and other moving or hazardous equipment which is remotely or automatically operated. Sign to be similar to Brady Number 88191.

C. Specific Equipment Requirements:

1. Power Distribution Equipment: Including, but not limited to switchgear, switchboards, distribution panelboards, branch panelboards and motor control centers.

   a. Identification label shall include the following:

   1) Equipment type and tag designation shown on the contract documents using 1/2 inch high bold lettering.
   2) Voltage and phase rating of the equipment using 1/4 inch high bold lettering.
   3) The name of the upstream equipment and location/room number it is located in using 1/4 inch high bold lettering.
   4) Rating and type of overcurrent protection device serving the equipment (e.g., "FED FROM 200A/3P CIRCUIT BREAKER") using 1/4 inch high bold lettering.
b. Example Identification Label:

**DISTRIBUTION PANEL ‘DP1’**

208Y/120V 3-Phase 4-Wire  
Fed from Panel MP1; Room 200  
Fed from 200A/3P Circuit Breaker

c. Distribution panelboards and switchboards shall be provided with permanent labeling adjacent to each overcurrent protection device indicating the load being served and the location of the equipment.

d. A typewritten directory of circuits shall be provided at all branch panelboards. Provide explicit description and identification of items served by each individual switch and circuit breaker.

2. Transformers:

a. Identification label shall include the following:

1) Equipment type and tag designation shown on the contract documents in 1/2 inch high bold lettering.

2) Voltage and phase rating of equipment using 1/4 inch high bold lettering.

3) The name of the upstream equipment and location/room number it is located in using 1/4 inch high bold lettering.

4) Rating and type of overcurrent protection device serving the equipment (e.g., "FED FROM 70A/3P CIRCUIT BREAKER") using 1/4 inch high bold lettering.

b. Example Identification Label:

**TRANSFORMER ‘T1’**

480V△:208Y/120V 75kVA  
Fed from Panel DP1; Room 200  
Fed from 125A/3P Circuit Breaker

3. Control Equipment: Including but not limited to disconnect switches, starters, variable-speed controllers, contactors, motor control centers, pushbutton stations, etc.

a. Identification label shall include the following:

1) Equipment type and tag designation shown on the contract documents of the actual equipment served in 1/2 inch high bold lettering.

2) Location of equipment being served in 1/4 inch high bold lettering. If the equipment being served by the control equipment is located in the same room, identify location as “THIS ROOM.”

3) Voltage and phase rating of equipment in 1/4 inch high bold lettering.

4) The name of the upstream equipment and location/room number it is located in using 1/4 inch high bold lettering.
b. Example Identification Label:

AHU-6 Supply Fan ‘AHU-6S’
Located in Mechanical Room 001
480V 3-Phase, 3 Wire
Fed from Distribution Panel MHEQ; Room 200

4. Power Transfer Equipment.
   a. Identification label shall include the following:

   1) Equipment type and tag designation shown on the contract documents in 1/2 inch high bold lettering.
   2) The power branch the power transfer equipment serves (e.g., CRITICAL, LIFE SAFETY, EQUIPMENT, NORMAL) in 1/2 inch high bold lettering.
   3) Voltage, phase rating and pole quantity of equipment using 1/4 inch high bold lettering.
   4) The name of upstream equipment and location/room number it is located in using 1/4 inch high bold lettering. Differentiate upstream sources by indicating Normally Closed (NC) and Normally Open (NO). If the upstream equipment supplying power is located in the same room as the power transfer equipment, identify location as “THIS ROOM.”
   5) The name of the downstream equipment and location/room number it is located in using 1/4 inch high bold lettering. If the downstream equipment being served is located in the same room as the power transfer equipment, identify location as “THIS ROOM.”

b. Example Identification Label:

AUTOMATIC TRANSFER SWITCH ‘ATS-C1’
CRITICAL POWER
480Y/277V 3-Phase, 4-Wire, 4-Pole
Upstream Source (NC): Fed from Panel ‘SB-1’; Room 200
Upstream Source (NO): Fed From Panel ‘SB-GP’; Room 201
Downstream: Feeds Distribution Panel ‘DP-C1’

END OF SECTION
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. Electrical coordination, materials and methods for electrical demolition associated with remodeling of an existing area or facility for re-use.

1.3 SELECTIVE DEMOLITION

A. This Section includes limited scope general construction materials and methods for application with electrical installations as follows:

B. Selective demolition including:

1. Nondestructive removal of materials and equipment for reuse or salvage as indicated.
2. Dismantling electrical materials and equipment made obsolete by these installations.
3. Miscellaneous metals for support of electrical materials and equipment required to remain.
4. Firestopping as required to maintain existing partition ratings.

1.4 PROJECT CONDITIONS

A. Conditions Affecting Selective Demolition: The following project conditions apply:

1. Protect adjacent materials indicated to remain. Install and maintain dust and noise barriers to keep dirt, dust and noise from being transmitted to adjacent areas. Remove protection and barriers after demolition operations are complete.
2. Locate, identify and protect electrical services passing through demolition area and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services must be interrupted, install temporary services for affected areas.
3. Maintain and protect existing building services that transit the area affected by selective demolition.

1.5 SEQUENCE AND SCHEDULING

A. Coordinate the shut-off and disconnection of electrical, fire alarm and communication services with the Owner and the utility companies. Coordinate any electrical outages required for service switchovers or connections with the Owner a minimum of five working days prior to the interruption. Comply with Owner's specific requirements for partial or complete outage requests.
B. All work that produces excessive noise and/or interference with normal building operations, as indicated on the drawings, shall be coordinated and scheduled with the Owner.

C. Assume that all required re-connection of existing systems or equipment not indicated for demolition must remain operational unless otherwise noted. Provide temporary connections to maintain electrical services and systems serving adjacent areas during required outages.

D. Maintain existing electrical service, electrical distribution, fire alarm and communication equipment in operation until the new electrical service or distribution equipment is energized, tested and accepted.

1.6 DRAWINGS AND SPECIFICATIONS

A. The architectural, structural, mechanical and electrical drawings and specifications shall be considered as mutually explanatory and complementary. Any electrical demolition work called for by one and not by the other shall be performed as though required by all. All sections and subsections of the Electrical work shall be governed by and subject to the general and supplementary conditions. Any discrepancies in or between the drawings and specifications, or between the drawings and actual field conditions shall be reported to the Engineer/Architect in sufficient time to issue an addendum for clarification.

B. The electrical drawings are diagrammatic and the drawings indicate the general layout of the electrical systems. Field verification of scale dimensions on plans is directed since actual locations, distance and levels will be governed by actual field conditions.

PART 2 - PRODUCTS

2.1 MATERIALS AND METHODS

A. Materials and methods required for removing, patching, connections, etc., shall be as specified in the associated specification sections.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL DEMOLITION

A. Comply with NECA 1.

3.2 EXAMINATION AND COORDINATION

A. Examine substrates, areas and conditions with Installer present for compliance with requirements for conditions affecting demolition.

B. Coordinate the demolition scope of work with the Owner and other Contractors to confirm that all required electrical demolition is addressed and scheduled to avoid disputes.

3.3 SELECTIVE DEMOLITION

A. The Electrical Contractor shall remove, cap and/or relocate equipment, outlets, conduit, wire, etc., as shown and specified on drawings and as may become necessary because of existing field conditions. It shall be the responsibility of the Electrical Contractor to visibly examine all existing walls designated for removal to determine the conduit and the
wiring that will require capping and/or removal, whether or not such conditions are indicated on the drawings. The contractor shall be held to having visited the site and taken all existing conditions into consideration.

B. Where the architectural drawings indicate that partitions, walls, ceilings, etc., are to be removed the Electrical Contractor shall be responsible for removal of all electrical components within those structures including equipment, lighting fixtures, lighting controls, wiring devices, raceways, wiring, electrical systems, etc.

C. In addition to the foregoing, comply with the following:

1. Maintain circuit continuity to all existing fixtures, equipment, outlets, etc., to remain in use whether noted on the plans or not. Field-verify existing items to remain in use. Wiring for existing circuits which must be re-routed or which are partially abandoned, shall be reconnected to service the remaining outlets on the circuit.
2. In the demolition work, remove all unused wiring and cables and unused conduit that is exposed or within accessible ceilings which is affected by and is in the area of the work of this contract.

D. The intention of the electrical demolition drawings is to disconnect and remove all electrical work made void by the scope of the construction and alteration. Field-verify exact material quantities required to be removed.

E. Abandoned electrical power distribution equipment, including switchboards, motor controllers, panelboards, lighting fixtures and controls and wiring devices shall be disconnected and removed unless otherwise noted. All supporting equipment for this equipment to be removed, including hangers, supporting rods, ballasts, etc., shall be removed.

F. All existing electrical work and associated raceway and wiring, which has been made obsolete by the work and/or is shown dashed on the electrical demolition drawings shall be disconnected and removed back to the source of power unless otherwise noted. Although an attempt has been made to indicate all of this work, total accuracy is not guaranteed. Contractor shall visibly examine all areas and walls and ceilings scheduled for removal to determine existing electrical items to remain.

G. Where electrical equipment, conduit, boxes and supporting hardware are removed, patch and finish the surface as required to match the existing unless otherwise noted.

H. Where buried conduits extending out of a concrete slab become abandoned, cut and grind the conduits off flush with top of slab and plug with non-shrink waterproof grout fill.

I. All removed materials, other than removed materials to be relocated, or stored or turned over to the Owner shall become the property of the Contractor and shall be removed from the project site.

J. Acceptance of contract means installer accepts existing conditions.

K. Contractor shall coordinate all demolition work with all other trades.

L. In walls or floors where a flush device is being removed, but the wall or floor remains or for any outlet which must remain, but has a device removed, provide a blank cover over
the outlet. Match the color and material of existing remaining covers in the room or space.

M. In areas where the partitions, ceilings, etc., are indicated to be temporarily removed, the Electrical Contractor shall be responsible for the disconnection, storage, re-installation and re-connection of equipment or devices within that partition, ceiling, etc., unless otherwise noted.

N. Legally dispose of hazardous materials and ballasts or other equipment containing PCBs and lamps containing mercury or equipment containing oil. Comply with all Federal, state, and local laws. This includes HID and fluorescent lamps determined to be hazardous waste. These shall be disposed of at a permitted hazardous waste disposal facility or other appropriately permitted entity.

O. Provide manifests and travel and disposal forms and documents to Owner when required by Owner or regulatory agencies.

3.4 CLEANING

A. Clean existing electrical distribution equipment affected by the project, including switchboards, motor controllers, panelboards, etc. Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide coverplates for openings. Modify existing panelboard directories (or replace) for panelboards which have had alterations to the circuits originating therein. Describe the load and location.

B. Where luminaires are indicated to be retained and re-used, the Electrical Contractor shall clean all exterior and interior surfaces. Lamps and ballasts shall be replaced with new. Broken electrical parts, including guards and lens shall be replaced to match existing construction unless otherwise noted.

3.5 FIRESTOPPING

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical demolition to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION
SECTION 26 24 16 - 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. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.

1.3 SUBMITTALS

A. Product Data: For each type of panelboard, switching 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.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections and details. Show tabulations of
   installed devices, equipment features and ratings such as voltage, main bus
   ampacity, integrated short circuit ampere rating, overcurrent protective device
   arrangement and sizes.
2. Include wiring diagrams for power, signal and control wiring.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain panelboards, overcurrent protective devices, components and
   accessories from single source from single manufacturer.

1. Exception – for circuit breakers added to existing Westinghouse panelboards and
   new panel covers for existing Westinghouse panelboards, shall be as
   manufactured by Eaton Cutler-Hammer.

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 NEMA PB 1 “Panelboards.”

E. Comply with NFPA 70 “National Electrical Code.”
1.5 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.

1.6 WARRANTY

A. Warranty: Panelboard and components shall be warranted to be free from manufacturing defects for a period of one year after project acceptance by Owner.

1.7 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.
   2. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Division 20 Section "Seismic Protection."

B. Enclosures: NEMA PB 1, Type 1, flush or surface mounted as shown on drawings.

   1. Rated for environmental conditions at installed location, unless otherwise noted on drawings, the following types shall be used in the listed locations:

<table>
<thead>
<tr>
<th>Location</th>
<th>NEMA Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry, clean indoor</td>
<td>NEMA 1</td>
</tr>
<tr>
<td>Outdoor or Damp or wet interior</td>
<td>NEMA 3R</td>
</tr>
</tbody>
</table>

2. Finishes:

   a. Panels and Trim: 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: Same finish as panels and trim.


C. Phase, Neutral, and Ground Buses:

   1. Material: Copper.
2. Main bussing shall be fully rated, non-tapered, ready to receive those overcurrent devices indicated as spaces without modifying the bus. Neutral bus to be rated at 100 percent of the main bus rating, capable of accepting terminations based on the maximum number of branch circuit protective devices allowed in the panelboard plus 6 additional conductors.

3. Equipment Ground Bus: Adequate for panelboard feeder and branch-circuit equipment ground conductors. Equipment ground bus shall be large enough and have sufficient quantity and sizes of terminations to allow for termination of panelboard feeder plus one equipment-grounding conductor per circuit, based on the maximum number of branch circuit protective devices allowed in the panelboard plus 6 additional conductors. Increase terminations to accommodate additional feeder conductors where double-lugged panelboards are indicated. When panelboards are multiple sections, provide equipment ground busses in each section of sufficient size for all grounding conductors in that section. Ground busses to be insulated from the panelboard enclosure where isolated ground busses are called for. Ground busses shall be bonded to enclosure when isolated ground buses are not called for.

D. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Main, Neutral, and Ground Lugs and Buses: Provide mechanical connectors for conductors. Provide necessary additional wire bending and terminating space when sub-feed and feed-through lugs are called for.

E. Future Devices: Mounting brackets, bus connections, filler plates and necessary appurtenances required for future installation of devices.

F. Overcurrent Protection Devices: Multiple pole overcurrent protection devices shall be provided with a common trip handle for all poles. Tandem circuit breakers are not allowed.

G. Panelboard Short-Circuit Current Rating: All distribution and branch circuit panelboards shall be fully rated to interrupt symmetrical short circuit current available at terminals. Series rated equipment is not allowed.

2.2 DISTRIBUTION PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

**240/120V 208Y/120V 480Y/277V and 480 V rated panelboards:**

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Panelboard</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Electric</td>
<td>Spectra Series</td>
</tr>
<tr>
<td>Siemens</td>
<td>P series</td>
</tr>
<tr>
<td>Square D</td>
<td>QMB/I-Line</td>
</tr>
<tr>
<td>Cutler-Hammer</td>
<td>Pow-R-Line 4F</td>
</tr>
</tbody>
</table>

B. Panelboards: NEMA PB 1, power and feeder distribution type.
C. Doors: Secured with vault-type latch with tumblers lock; keyed alike.
   1. For doors more than 36 inches (914 mm) high, provide two latches, keyed alike.

D. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
   1. Circuit Breakers: Provide molded-case, thermal-magnetic, trip-free, bolt-on circuit breakers (unless otherwise noted), replaceable without disturbing adjacent units. Circuit breaker escutcheon shall have ON and OFF markings. Circuit breaker handle accessories shall provide provisions for locking handle in the "ON" or "OFF" position. Circuit breaker faceplate and handle shall indicate rated ampacity. Circuit breaker faceplate shall indicate UL certification standards with applicable voltage systems and corresponding AIC ratings. Circuit breakers 30 amperes and less shall be UL listed to accept copper conductors with insulation rated at 75 degrees Celsius, with conductors sized from the 60 degree Celsius column of Table 310.15(B)(16) of the NEC. Circuit breakers larger than 30 amperes shall be UL listed to accept copper conductors with insulation rated at 75 or 90 degrees Celsius with conductors sized from the 75 degree Celsius column of Table 310.16 of the NEC.
   3. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field adjustable trip setting.
   4. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
      a. Instantaneous trip.
      b. Long- and short-time pickup levels.
      c. Long- and short-time time adjustments.
      d. Ground-fault pickup level, time delay, and $I^2t$ response.

2.3 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.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Doors: Hinged front cover, entire front trim hinged to box and with standard door within concealed hinged trim cover (door-in-door). Provide flush locks, keyed alike.

D. Interiors: Provide physical means to prevent installation of more overcurrent protection devices than the quantity for which the enclosure was listed. Interiors shall be field convertible for top or bottom feed.

E. Circuit Numbering: Provide factory fabricated circuit numbers adjacent to each circuit breaker pole position. Numbering shall be continuous from topmost pole position to last possible pole position. Number sequence on left shall be 1-3-5-7, etc., and number
sequence on right shall be 2-4-6-8, etc. Numbering material shall be insertable or strip type, as manufactured by the panelboard manufacturer for the specific panelboard. Adhesive markers and pen type markers are not acceptable.

F. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Circuit Breakers: Provide molded-case, thermal-magnetic, trip-free, bolt-on circuit breakers (unless otherwise noted) replaceable without disturbing adjacent units. Circuit breaker escutcheon shall have ON and OFF markings. Circuit breaker handle accessories shall provide provisions for locking handle in the "ON" or "OFF" position. Circuit breaker faceplate and handle shall indicate rated ampacity. Circuit breaker faceplate shall indicate UL certification standards with applicable voltage systems and corresponding AIC ratings. Circuit breakers 30 amperes and less shall be UL listed to accept copper conductors with insulation rated at 60, 75 and 90 degrees Celsius, with conductors sized from the 60 degree Celsius column of Table 310.15(B)(16) of the NEC. Circuit breakers larger than 30 amperes shall be UL listed to accept copper conductors with insulation rated at 75 or 90 degrees Celsius with conductors sized from the 75 degree Celsius column of Table 310.16 of the NEC.

2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits; Type HACR for feeding heating, air conditioning or refrigeration loads. Provide UL Class A ground fault interrupter circuit breakers where scheduled on drawings. Arc fault circuit breakers shall comply with UL 1699; 120/240-V, single-pole configuration.

G. Short Circuit Rating: Provide short circuit rating for each panelboard as indicated on drawings. Ratings indicated are minimum values. Manufacturer shall provide the next larger rating if the value indicated is unavailable.

2.4 OVERCURRENT PROTECTIVE DEVICE ACCESSORY OPTIONS

A. Ground-Fault Protection: Integradly mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.

B. Shunt Trip: 120V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.

C. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.

D. Alarm Switch: Single-pole, normally open contact that actuates only when circuit breaker trips.

E. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in the "ON" or "OFF" position.

F. Handle Clamp: Loose attachment for holding circuit-breaker handle in on position.
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. Install panelboards and accessories according to NEMA PB 1.1.

B. Mounting height: Mount panelboards such that the center grip of any operating handle, when in its highest position, is not more than 79 inches above the floor. Align top edges of panelboard covers where multiple panelboards are installed in the same general area.

C. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit breaker trip ranges as dictated on drawings.

D. Install filler plates in unused spaces.

E. Stub four 1-inch empty conduits from each recessed panelboard into accessible ceiling space or space designated to be ceiling space in the future.

3.3 IDENTIFICATION

A. Comply with requirements within Division 26 Section "Identification for Electrical Systems."

B. Circuit Directory: Provide typed circuit directory reflective of final circuit changes. Identify all circuits including spares. Spaces shall be left blank. Circuit designations shall describe the load type and location. For example, “Lighting - North Corridor” or “Receptacles - Rooms A, B, C and X, Y, Z.” Use Owner's room designations, not designations shown on the plans, if different. Type on cardboard stock installed behind clear acrylic holder enabling removal of the directory.

3.4 FIELD QUALITY CONTROL

A. Visual and Mechanical Inspection: Include the following inspections and related work:

1. Inspect for defects and physical damage, labeling and nameplate compliance with requirements of up-to-date drawings and panelboard schedules.

2. Exercise and perform operational tests of all mechanical components and other operable devices in accordance with manufacturer's instruction manual.

3. Check panelboard mounting, area clearances, alignment and fit of components.

4. Check tightness of bolted electrical connections with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.
B. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.

1. Measure as directed during period of normal system loading.
2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.
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. Twist-locking receptacles.
3. Receptacles with integral surge suppression units.
4. Snap switches.
5. Pendant cord-connector devices.
6. Cord and plug sets.
7. Floor service outlets, poke-through assemblies.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.
B. GFCI: Ground-fault circuit interrupter.
C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
D. RFI: Radio-frequency interference.
E. TVSS: Transient voltage surge suppressor.
F. UTP: Unshielded twisted pair.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

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. Comply with NFPA 70.

C. Comply with UL 498: “Attachment Plugs and Receptacles.”

D. Comply with UL 943: “Ground-Fault Circuit-Interrupters.”
E. Listing and Labeling: Provide products which are listed and labeled by Underwriters Laboratories for their applications and installation conditions and for the environments in which installed.

PART 2 - PRODUCTS

2.1 WIRING DEVICES

A. Comply with NEMA Standard WD 1, "General Purpose Wiring Devices" and NEMA Standard WD6 "Wiring Device Dimensional Requirements."

B. Enclosures: NEMA 1 equivalent, except as otherwise indicated.

C. Receptacles, Straight-Blade and Locking Type: Except as otherwise indicated, comply with UL Standard 498, "Electrical Attachment Plugs and Receptacles." Provide UL labeling of devices to verify these compliances. Provide straight blade receptacles per table on the following page.

D. At contractor option, receptacles having plug tail connectors consisting of a female at the receptacle and a matching male on the pigtail are acceptable provided that that ratings and listings and other portions of this specification apply. The receptacle shall have no exposed parts or wiring when the mating connector is installed.

2.2 STRAIGHT BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Cooper: 5352.
   b. Hubbell: 5352.
   c. Leviton: 5352.

2.3 GFCI RECEPTACLES

A. General Description: Straight blade, 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. Products: Subject to compliance with requirements, provide one of the following:
   b. Hubbell: GF20L.
   c. Leviton: 7899.

C. Weather-Resistant, Duplex GFCI Convenience Receptacles:

1. Products: Subject to compliance with requirements, provide one of the following:
2.4 TVSS RECEPTACLES

A. General Description: Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 1449, with integral TVSS in line-to-ground, line-to-neutral, and neutral-to-ground.

1. TVSS Components: Multiple metal-oxide varistors; with a nominal clamp-level rating of 400 volts and minimum single transient pulse energy dissipation of 240 J, according to IEEE C62.41.2 and IEEE C62.45.

2. Active TVSS Indication: Visual and audible with light visible in face of device to indicate device is "active" or "no longer in service."

B. Duplex TVSS Convenience Receptacles:

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Cooper: 5362BLS.
   b. Hubbell: HBL5360SA.
   c. Leviton: 5380.
   d. Pass & Seymour: 5262SP.

2. Description: Straight blade, 125 V, 20 A; NEMA WD 6 configuration 5-20R.

2.5 TWIST-LOCKING RECEPTACLES

A. Locking or special type to be of NEMA configuration called out for the specific application on the drawings.

B. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Cooper: L520R.
   b. Hubbell: HBL2310.
   c. Leviton: 2310.
   d. Pass & Seymour: L520-R.

2.6 PENDANT CORD-CONNECTOR DEVICES

A. Description: Matching, locking-type plug and receptacle body connector; NEMA WD 6 configurations L5-20P and L5-20R, heavy-duty grade.


2. External Cable Grip: Woven wire-mesh type made of high-strength galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.
2.7 CORD AND PLUG SETS

A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.

1. Cord: Rubber-insulated, stranded-copper conductors with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.
2. Plug: Male configuration with nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.8 SNAP SWITCHES

A. Snap Switches: Quiet-type a.c. switches, Underwriters Laboratories listed and labeled as complying with UL Standard 20 "General Use Snap Switches." Switches shall be heavy duty industrial rated, 20A, 120/277V, ivory handle, back and side wired, number of poles as required, with ground screw.

B. Comply with NEMA WD 1 and UL 20.

C. Switches, 120/277 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Cooper: 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
   b. Hubbell: HBL1221 (single pole), HBL1222 (two pole), HBL1223 (three way), HBL1224 (four way).
   c. Leviton: 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
   d. Pass & Seymour: 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).

2.9 WALL PLATES

A. Single and combination types to match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
3. Material for Weatherproof, Damp Locations: high impact polycarbonate “while in use” style, Raco Rayntite II or equal. For switch covers, Carlon E98TSCN or equal.

B. Device Enclosures for Outdoor and Other Wet and Damp Locations: Enclosure shall be suitable for wet locations while in use in accordance with Article 406.8 (B) and listed and labeled for the specific use by Underwriters Laboratories. Enclosure shall be clearly and visibly marked by the factory with the wording “Suitable For Wet Locations While In Use.” Enclosure shall be non-metallic with hinged clear cover and integral key operated cover lock. Cover to have two exit holes for up to 3/8 inch diameter cords with holes located at bottom of cover. Provide cover with device opening matched to type of wiring device used, e.g., duplex receptacle, GFCI receptacle, and toggle switch.
2.10 FLOOR SERVICE FITTINGS

A. Type: Modular, flush-type, dual-service units suitable for wiring method used.

B. Compartments: Barrier separates power from voice and data communication cabling.

C. Service Plate: Round Die-cast aluminum with satin finish.

2.11 POKE-THROUGH ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Hubbell.
   2. Walker.
   3. Wiremold.
   4. Thomas & Betts.

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 one duplex receptacle and space for two RJ-45 jacks.
   2. Size: Selected to fit nominal 4-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 4-inch cored openings and reestablish fire rating of floor.
   5. Wiring Raceways and Compartments: For a minimum of four No. 12 THHN AWG conductors and a minimum of two, 4-pair, Category 6 voice and data communication cables.
   6. Cover Options: Color coordinated with architect.

2.12 FINISHES

A. Color: Wiring device catalog numbers in Section Text do not designate device color.
   1. Wiring Devices Connected to Normal Power System: Ivory, unless otherwise indicated or required by NFPA 70 or device listing.
   2. Wiring Devices Connected to Emergency Power System: Red
   3. TVSS Devices: Blue

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1 including the mounting heights listed in that standard, unless otherwise noted.

B. Coordination with Other Trades:
1. Take steps to ensure 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 device boxes in brick or block walls so that the coverplate does not cross a joint unless the joint is troweled flush with the face of the wall.

4. Install wiring devices after all wall preparation, including painting, is complete. Protect devices and assemblies during painting if installed prior to wall painting.

C. 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 pigtailed.

4. Existing Conductors:
   a. Cut back and pigtail, or replace all damaged conductors.
   b. Straighten conductors that remain and remove corrosion and foreign matter.
   c. Pigtailing existing conductors is permitted provided the outlet box is large enough.

D. 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 pigtailed 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. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtailed for device connections.

8. Tighten unused terminal screws on the device.

9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

10. Install devices and assemblies plumb and secure.

11. Install wall plates when painting is complete.

12. Utilize weather-resistant receptacles in wet or damp locations and outdoors.

13. For all devices mounted flush in walls where communications backboards are installed, provide extension ring with sufficient depth for the outlet and coverplate to mount flush to the face of the communications backboard. Devices and
coverplates that mount recessed to the communications backboard are not acceptable.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Arrangement of Devices: Unless otherwise indicated, mount flush with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multi-gang wall plates.

H. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 IDENTIFICATION

A. Comply with Division 26 Section "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943 and per manufacturer's recommendations.
5. Test wiring devices for proper polarity and ground continuity. Operate each operable device at least 6 times.
6. Using the test plug, verify that the device and its outlet box are securely mounted.
7. 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.
8. Check TVSS receptacle indicators for normal indication.
9. Replace damaged or defective components.
3.4 CLEANING

A. General: Internally clean devices, device outlet boxes, and enclosures. Replace stained or improperly painted wall plates or devices.

END OF SECTION
SECTION 26 51 00 - LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior luminaires and accessories.
2. Exterior luminaires, poles, and accessories.
3. Lamps and ballasts.
4. Emergency lighting units and exit signs.
5. Luminaire supports.

B. Related Sections:

1. Section 26 0923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, digitally addressable lighting control systems, and multi-pole lighting relays and contactors.

1.2 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color-rendering index.

C. HID: High-intensity discharge.

D. LED: Light Emitting Diode

E. LER: Luminaire efficacy rating.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting fixture, including ballast housing if provided.

H. Pole: Luminaire support structure, including tower used for large area illumination.

1.3 SUBMITTALS

A. For each type of luminaire, arranged in order of luminaire designation. Include complete product model number and product data sheets on features, accessories, finishes, and the following:

1. Physical description of luminaire including dimensions, as well as effective projected area for exterior luminaires.
2. Details of attaching luminaires and accessories.
3. Emergency lighting units including battery and charger.
4. Ballast, including ballast factor (BF).
5. Life, output (lumens, CCT, and CRI), and energy-efficiency data for lamps.
6. LED photometric report per latest IESNA LM-79-08 testing guidelines, including luminaire model number, manufacturer of LED chip array/board and driver, input...
wattage, and independent testing laboratory name, report number, and date tested.

7. Dimmer device data for all LED luminaires specified as dimming. Must be from approved manufacturer per luminaire manufacturer requirements, furnished and installed by contractor. Contractor responsible for dimmer control and luminaire compatibility.

8. Pole information including: Materials, dimensions, finishes, means of attaching luminaire to support, anchor bolts and templates, structural analysis and manufactured pole foundations.

B. Custom Luminaires: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

2. Wiring Diagrams: For power, signal, and control wiring.

1.4 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. LED Chip Arrays/Boards: 3 for every 100 of each type and rating installed. Furnish at least one of each type.

2. Ballasts and LED Drivers: 1 for every 100 of each type and rating installed. Furnish at least one of each type.

3. Diffusers, Lenses, Globes and Guards: 2 for every 100 of each type and rating installed. Furnish at least one of each type.

4. Glass and Plastic Lenses: 2 for every 100 of each type and rating installed. Furnish at least one of each type.

5. Globes and Guards: 1 for every 20 of each type and rating installed. Furnish at least one of each type.

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, or by an independent agency complying with the IESNA Lighting Measurements Testing & Calculation Guides.


1.6 COORDINATION

A. Coordinate layout and installation of luminaires 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 DELIVERY, STORAGE, AND HANDLING

A. Deliver luminaire and components to site. Store such that luminaires, finishes, lenses, and trims are protected. Install with protective films on and remove only after construction clean-up is complete.
B. Store poles on decay-resistant-treated skids at least 12 inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation. Prevent breakage and damage to finish.

1.8 WARRANTY

A. Warranty Period for LED chips/arrays and drivers: 5 years from date of substantial completion.

B. Warranty Period for Luminaires: 5 years from date of substantial completion.

C. Warranty Period for Poles: 3 years from date of substantial completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Refer to Luminaire Schedule on the drawings.

2.2 GENERAL REQUIREMENTS FOR LUMINAIRES AND COMPONENTS

A. All luminaires shall carry a UL listing, unless otherwise noted on the Luminaire Schedule. Exterior luminaires shall carry a UL wet location listing as well as designated IP rating, unless otherwise noted on the Luminaire Schedule.

B. Recessed Luminaires: Housing shall be constructed of steel or aluminum, free of burrs and sharp corners and edges, free of light leakage and accessible without use of tools. Components shall be formed and supported to prevent warping and sagging. Lamp and ballast compartments shall be accessible from below the ceiling.

1. Lensed fluorescent troffers shall be provided with hinged door frames and positive spring-loaded latches, UV stabilized acrylic prismatic lenses with a minimum of 0.12 inch thickness, unless otherwise noted on the Luminaire Schedule.

2. Parabolic louvers shall be interlocking low-iridescent, specular anodized aluminum in construction. Number of cells shall be specified on Luminaire Schedule.

3. Direct/Indirect luminaire lamp chambers shall be made of one-piece perforated steel. Reflectors shall have a minimum reflectance of 90 percent.

4. Volumetric luminaires shall have UV stabilized acrylic lens with optical pattern as designated on Luminaire Schedule. Reflectors shall have a minimum reflectance of 90 percent.

5. Where fire-rated ceilings are specified, luminaires should be provided with listed enclosures meeting requirements to maintain fire-rated system rating.

C. Suspended Luminaires: Canopies, power feeds, and mounting accessories shall be coordinated with architectural-designated ceiling type. Luminaires shall be installed plumb and level at luminaire height designated on Luminaire Schedule.

D. Exterior Luminaires: Housings shall be rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Doors shall be removable for cleaning or replacing lenses, designed to disconnect ballast when door opens.
1. Diffusers and Globes: Acrylic Lighting Diffusers shall be 100 percent virgin acrylic plastic, minimum 0.125 inch thickness. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation. Glass globes shall be annealed crystal glass unless otherwise indicated.

2. In-grade luminaires shall have separate compartments for wire entry and lamp chamber, separation shall prevent surface temperature of exceeding 115 degrees F.

2.3 LIGHT EMITTING DIODE (LED) LUMINAIRE SYSTEMS

A. Light emitting diodes shall have a minimum color rendering index (CRI) of 80 for interior applications and 70 for exterior applications. Refer to Luminaire Schedule for color temperature of the luminaires.

B. Color changing LED chip arrays shall have chip colors as noted on the Luminaire Schedule.

C. LED chips shall be wired so that operation of chip array is not prohibited by failure of one chip.

D. LED Driver:

1. Solid state driver with integral heat sink. Driver shall have overheat, short-circuit and overload protection, power factor 0.90 or above and maximum total harmonic distortion of 20 percent. Surge suppression device for all exterior luminaires.

2. Drivers shall have dimming capabilities as outlined in the luminaire schedule for each luminaire type.

3. Driver shall have a minimum of 50,000 hours rated life.

2.4 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.

2.5 EMERGENCY INVERTER – LED LUMINAIRES

A. Individual Unit: Self-contained, with automatic transfer to battery supply on loss of normal power, UL 924 listed for factory of field installation in indoor and damp locations.

B. Battery: Sealed, high temperature, maintenance free, nickel cadmium battery with capacity to provide 90 minutes of emergency operation at full lumen output, with 24-hour recharge time, seven (7) year minimum battery life expectancy.

C. Features: Integral battery charger with LED charging indicator light, test switch, electronic circuitry for use with LED drivers. Output of inverter shall be sinusoidal with solid-state low voltage disconnect circuit.

D. Inverter to be mounted remote and adjacent to luminaire shown on drawings. Inverter to be accessible from below ceiling through luminaire opening.
E. Charging indicator LED and test switch to be mounted in remote test/monitor plate provided with inverter [OR] integral to luminaire.

F. Inverter capable of operating a switched, dimmed, or unswitched luminaire up to 30 watts at full lumen output.

G. Warranty: Emergency inverter shall have a full five (5) year, non-prorated warranty.

2.6 LUMINAIRE SUPPORT COMPONENTS

A. Comply with Section 26 0529 "Hangers and Supports" for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single luminaire. Finish same as luminaire.


E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage.

F. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

G. Hook Hangers: Integrated assembly matched to luminaire and line voltage and equipped with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Luminaires:

1. Set level, plumb, and square with ceilings and walls unless otherwise indicated.
2. Install lamps in each luminaire.

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 reinstall.

C. Remote Mounting of Ballasts: Distance between the ballast and luminaire shall not exceed that recommended by ballast manufacturer. Verify, with ballast manufacturers, maximum distance between ballast and luminaire.

D. Lay-in Ceiling Luminaire Supports: Use grid as a support element.

1. Install ceiling support system rods or wires independent of the ceiling suspension devices, for each luminaire. Locate not more than 6 inches from luminaire corners.
2. Support Clips: Fasten to luminaires and to ceiling grid members at or near each luminaire corner with clips that are UL listed for the application.
3. Luminaires of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support luminaires independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.

4. Retain subparInstall at least one independent support rod or wire from structure to a tab on luminaire. Wire or rod shall have breaking strength of the weight of luminaire at a safety factor of 3.

E. Suspended Luminaire 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 luminaire chassis, including one at each end.
4. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.

F. When installing luminaires, the contractor shall use the luminaire manufacturer’s mounting hardware and follow all manufacturer’s installation direction.

G. All recessed downlights must be installed so that the bottom of the throat is even with the finished ceiling plane. The overlapping flange must then fit flush to the ceiling plane/throat. No light leak must be visible. All miscellaneous hardware above the ceiling plane to accomplish the above shall be included in the base bid.

H. All recessed downlights shall have self-flanged reflectors unless otherwise noted.

I. When installing compact fluorescent lamp luminaires, consistent lamp orientation shall be maintained in a given area.

J. When luminaires are installed in continuous rows of 2 or more, luminaires shall be approved for use as wireway.

K. Alignment: Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on the pole.

L. Embedded Poles: Set poles to depth below finished grade indicated on Drawings, but not less than one-sixth of pole height, installed plumb with double nuts for adjustment. Grout around pole anchor base.

M. Raise and set poles using web fabric slings (not chain or cable), or non-chafing ropes.

N. Bollards and Ground-Mount Luminaires: Align units for optimum directional alignment of light distribution. Install on concrete base with top 4 inches above finished grade or surface at bollard location. Cast conduit into base, shape base to match shape of bollard base. Finish by troweling and rubbing smooth.

O. Ground metal and non-metallic poles and support structures according to Section 26 0526 “Grounding and Bonding.”

3.2 IDENTIFICATION

A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Section 26 0553 "Identification for Electrical Systems."
3.3 FIELD QUALITY CONTROL

A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

B. Verify that self-luminous exit signs are installed according to their listing and the requirements in NFPA 101.

C. Illumination Observations: Verify normal operation of luminaires after installing luminaires and energizing circuits with normal power source.

D. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.4 STARTUP SERVICE

A. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by Owner. Burn-in fluorescent and compact fluorescent lamps intended to be dimmed, for at least 100 hours at full voltage.

3.5 ADJUSTING AND CLEANING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting aimable luminaires to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose. Some of this work may be required after dark.

B. Align luminaires and clean lenses and diffusers at completion of work. Clean paint splatters, dirt, and debris from installed luminaires. Touch up luminaire and pole finishes as necessary.

C. Inspect each installed luminaire for damage. Replace damaged luminaires and components.

END OF SECTION
27.00.00  COMMUNICATIONS

27.01.00  SCOPE OF WORK

1. This specification covers the furnishing and installation of materials for telecommunications system structured cabling, complete and in operating condition as indicated on drawings and/or as described herein.
   1.1. The telecommunication systems herein specified provides for Information outlets and other low voltage signaling functions (such as for energy management and security systems) through twisted pair, fiber optic, and coaxial cable.
   1.2. The system shall provide acceptable outlets for any telecommunication device, which requires connection to other devices, networks or information services serving general university needs.

2. Products shall be as listed in this document or as directed by the Owner.

3. Installation procedures shall be in accordance with industry acceptable practices, product manufacturer’s recommendations, federal, state and local codes and standards, and shall include demolition and removal of materials as required to support the work.

4. This section includes tools, materials, equipment and labor necessary to complete a turnkey installation, including but not limited to the following items, which will be supplied by contractor unless otherwise noted by the University:
   4.1. Cable trays, hangers, and mounting hardware
   4.2. Conduit
   4.3. Connecting blocks
   4.4. Cross connect cable
   4.5. Cross connect rings or spools
   4.6. Equipment racks, mounting hardware and wire management
   4.7. Labels for cables and receptacles
   4.8. Modular station receptacles
   4.9. Mounting brackets
   4.10. Painted Fire Retardant plywood backboards
   4.11. Riser cable
   4.12. Station blocks
   4.13. Station cables
   4.14. Velcro Tie wraps, bushings, and miscellaneous

27.02.00  REFERENCES

27.02.10  APPLICABLE CODES and STANDARDS

Telecommunication design shall comply with Federal and State codes, regulations, and standards with variances adopted as standards by Indiana University and the State of Indiana. Applicable state and national standards include the latest editions of:
1. **OUTSIDE PLANT**: Transmission facilities used in the distribution of voice, data, or video from point where it leaves one building and enters another, including copper, coax, fiber optics, and microwave.

2. **ENTRANCE CABLE**: The outside plant cable(s) that enter the building from the campus outside plant communication distribution network.

3. **MAIN BUILDING TELECOMMUNICATION EQUIPMENT ROOM (IDF-1)**: The main telecommunication room located where the outside plant cabling and backbone cabling (risers) are interconnected.
   3.1 This room may also serve as a floor telecommunication equipment room (IDF-2).
   3.2 Telecommunications equipment rooms shall not house systems other than telecom systems; servers, security system monitors, fire alarm monitors, building IP camera monitoring systems, audio systems, mechanical systems conduit and components, plumbing systems conduit and components, HVAC ducting and components, electrical and other systems requiring access by non-UITS personnel must be located in other spaces.

4. **FLOOR TELECOMMUNICATION EQUIPMENT ROOM (IDF-2)**: A telecommunication equipment
4.1. Floor equipment rooms must be spaced such that the length of any horizontal cable run shall not exceed 295 feet, wire length, termination to termination.

5. **BACKBONE CABLE (Riser):** Cabling from the Building Telecommunication Equipment Room (IDF-1) to each Floor Telecommunication Equipment Room, including copper, coax, and fiber optics cabling.

6. **STATION OUTLET BOX:** The standard outlet box for telecommunications terminations shall be a double gang 5”x5”x2-7/8” minimum depth box, with mud ring sizes as required.

7. **INFORMATION OUTLET:** An assembly of interface ports for copper (data), coaxial (campus television), and fiber terminations (data); variations of arrangements are describe elsewhere in this document.

### 27.04.00 EXECUTION

#### 27.04.10 QUALITY ASSURANCE

1. Contractor’s management team shall have demonstrated compliance with all applicable Indiana University UITS installation requirements as a prime contractor or subcontractor on no less than three (3) Indiana University projects.
   1.1. The University may, at its discretion, require the names, previous project list, and references for the Contractor’s management team and field personnel assigned to this project prior to the start of the work.
   1.2. The University maintains the right to ask for replacement of management or field staff at any time during the project.

2. All cabling shall meet ANSI/TIA-568.

3. Termination and testing of the telecommunication cabling shall be performed by qualified telecommunication installer with at least 5 years experience that can assure the installation and testing parameters are met.
   3.1. Experience with Category 6e installation is required.
   3.2. Certification in training for Category 6A is required for Cat 6A jobs; experience in Category 6A installation is preferred.
   3.3. Vendors and contractors shall have on staff a Building Industry Consulting Service International (BICSI) Registered Communications Distribution Designer (RCDD).
   3.4. The Vendor shall provide the name and stamp number of the RCDD assigned to this project to the appropriate UITS representative.
   3.5. The RCDD shall approve construction design and upon completion of installation, certify compliance with the standards and installation practices as specified by this document.

4. Prior to commencing the work of this section, the contractor shall convene a meeting with Construction Manager, University Information Technology Services representative, and Engineering Services representative.
   4.1. The meeting will cover Project Specifications, Addendum, Change orders, IDF layouts, labeling, and other project work, documents and site conditions.
   4.2. System testing procedures and requirements shall be confirmed at this time.
   4.3. Test report forms and schedules shall be provided for University review.
   4.4. Inspection milestones will be set and notifications scheduled.
   4.5. Meeting minutes will be distributed and will include agreements, action items and responsible party(s), for this meeting and for future meetings when required.
5. Store materials and equipment in dry, environmentally controlled space. Do not install equipment and materials until spaces are enclosed, watertight, and dry. Protect equipment from dust and other airborne materials.

6. Contractor’s regular job progress meetings with the Construction Manager and other university representatives shall include a University Information Technology Services telecommunications representative.

7. University Inspection: Indiana University will provide advising as requested.
   7.1. The Office of University Information Technology Services may inspect the job as it progresses.
   7.2. Prior to final acceptance of the work, the Contractor shall make arrangements with the appropriate authorized University personnel to inspect the construction areas, both to ensure satisfactory completion of the work and to ensure complete cleanup and restoration of areas affected by the work.
   7.3. Temporary protection, coverings, and structures shall be removed at or before time of inspection.
   7.4. Examine areas and conditions with the Installer present for compliance with requirements and other conditions affecting the performance of telecommunication transmission media.
   7.5. Areas such as ceilings, which will be enclosed permanently (ie, drywall) or accessible (ie, lay-in ceilings), and which contain telecommunications cabling, must be inspected by the appropriate University UITS representative before enclosure; if not, enclosing materials will be removed and replaced for inspection at no extra cost to the University.
   7.6. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to the appropriate University personnel.

27.04.20 SUBMITTALS

1. Submit shop drawings and/or manufacturer's product data for telecommunications equipment, including termination equipment, copper cables, fiber optic cables, cable routing devices, and associated equipment and materials.
   1.1. Include cut sheets with rated capacities, operating characteristics, electrical characteristics and other measurements and descriptions which describe these items in detail.

2. Submit manufacturer's test reports and test data for each of the fiber optic cables installed.
   2.1. The test reports must clearly identify which fiber corresponds with the respective test measurement data so that the results can be verified prior to installation of the cable.

3. Submit a schedule of material and an installation schedule based on the construction schedule and construction phasing, to the Architect/Engineer, within three (3) weeks after contract award.

4. Submit qualifications data for material installers, supervisors, and the project RCDD (Registered Communications Distribution Designer).

5. Submit completed cable records, including floor plans, riser diagrams, manhole diagrams, footages on any cable other than horizontal cabling, and jack id's by location.

6. Submit test reports to the Owner's Representative for approval.
   6.1. Include in the test reports the test data taken and converted values.
   6.2. Prior to submittal for approval, have test reports signed by authorized witnesses present at tests.
   6.3. Submit electronic final copies of approved test reports in tester native format to the Owner's representative.
   6.4. No services shall be installed until verified reports are submitted, reviewed, and found to be acceptable by the appropriate University Information Telecommunication Services (UITS) representative.
27.04.30 DELIVERY, STORAGE and HANDLING

1. Deliver wire and cable properly packaged in factory-fabricated type containers, or wound on NEMA-specified type wire and cable reels.

2. Store wire and cable in clean dry space in original containers, following manufacturer’s storage guidelines. Protect products from weather, damaging fumes, construction debris and traffic.

3. Handle wire and cable carefully to avoid abrading, puncturing, kinking, and tearing wire and cable insulation and sheathing. Ensure that dielectric resistance and characteristic impedance integrity of transmission media are maintained.

27.04.40 SEQUENCING and SCHEDULING

1. Coordinate with installation of wires/cables, electrical boxes and fittings, cable trays, and raceways.

2. Sequence installation of optical-fiber cabling systems with other work to minimize possibility of damage during construction.

3. Interruptions to existing voice, data and video systems should be avoided where at all possible.
   3.1. If it becomes necessary to interrupt voice and/or data network services, then such interruptions must be approved by and scheduled with UITS Change Management.

   3.2. Approval is gained by submitting an MOP (Method of Procedure) to the UITS project contact person, containing the following information:
       3.2.1. Detailed account(s) of the work to be performed
       3.2.2. Proposed outage time(s)
       3.2.3. Estimated service restoral time(s)
       3.2.4. A contingency plan in case the work takes longer than anticipated, or doesn’t go as scheduled.

   3.3. Change Management meetings are held on Wednesday of each week
       3.3.1. The MOP should be submitted to the UITS project contact person no later than 4:00 pm on the Tuesday of the week in which the work is to be performed.
       3.3.2. Outages and associated work should be performed outside of peak hours, such as on weekends, or after 5:00 pm and before 7:00 am during the week.
       3.3.3. Actual time(s) first should be approved by the parties affected by the outage(s).
       3.3.4. No outages may be scheduled during the first two weeks of a fall or spring semester, during which time there is a “Change Freeze” period.

   3.4. Approval from UITS Change Management must be granted before any scheduled outages can be performed.
       3.4.1. If the outage is disapproved, then an updated MOP will need to be resubmitted on the following Tuesday, to be reviewed the following day.

   3.5. Contractors are solely responsible for:
       3.5.1. making all necessary access arrangements in ample time before the work begins.
       3.5.2. notifying the affected parties of the scheduled outage(s).
       3.5.3. notifying repair@indiana.edu

   3.6. Interruptions to video systems should be coordinated with the IU Building Systems division at
4. When new IDF’s are constructed as part of the project, communications work must be completed, tested and accepted four (4) weeks in advance of the substantial completion date, to ensure that necessary communications circuits will be available for required building systems such as elevator phones, environmental systems monitoring and security systems.

4.1. This includes all IDF associated electrical, HVAC, and door lock systems, as well as riser and outside plant copper and fiber cables, as necessary to allow the permanent installation of voice grade circuits and data network equipment.

27.04.50 GENERAL INSTALLATION

1. No cable shall be installed in any facilities other than those intended for that use.
1.1. Gas pipe and water pipes must not be used for conduit under any circumstances.

2. Install telecommunication transmission media as indicated, in accordance with manufacturer's written instructions, in compliance with applicable requirements of NEC, and in accordance with recognized industry practices.

3. CMP (Plenum) type cable will be used for all telecommunications cables.

4. Coordinate transmission media installation work, as necessary to properly interface installation of media with other work.

5. Do not install compressed, kinked, scored, deformed or abraded cable, or allow such damage to occur.
5.1. Damaged materials shall be removed from the job site immediately.

6. Use extreme care in handling, fishing, and pulling-in transmission media to avoid damage to conductors, shielding and jacketing/cladding.
6.1. Use pulling means including fish tape, cable, rope, and basket weave wire/cable grips, which will not damage media or raceway.
6.2. If power equipment is used to pull cable, the pull speed must not exceed 30 meters per minute.
6.3. Use water based lubricant approved by the cable manufacturer to ensure manufacturer’s pulling tensions are not exceeded.
6.3.1. Compound used must not deteriorate conductor or insulation.
6.4. Cable bending radii must not be exceeded.
6.5. Pulling methods must not cause cable to twist.
6.6. Cables pulled through pull boxes shall be hand assisted to prevent the cable from being crushed, kinked, or scraped.

7. Provide pull strings in telecommunication conduit.
7.1 To facilitate future cable installations, install a nylon pull cord in each conduit simultaneously with the pull-in of cable.

8. Pull conductors simultaneously where more than one is being installed in same raceway.

10. Splices in building media runs are NOT permitted.
10.1. Building wiring must be continuous and undamaged from outlet to connecting block or connecting block to connecting block.

11. Terminations shall be made with the manufacturer's stated tools and in accordance with manufacturer's
12. Tighten connectors and terminals, including screws and bolts, in accordance with manufacturer’s published torque-tightening values. Where manufacturer’s torque requirements are not indicated, tighten connectors and terminals to comply with tightening torque specified in UL Std.

13. When necessary within IDF’s, horizontal Station cables shall be secured with Velcro tie wraps. Both Fiber and Copper Entrance and riser cable shall be secured with standard tie wraps. Observe the manufacturer’s recommendations for distances between tie wraps and tightening tension from tie wraps and as specified in ANSI/TIA-568.

13.1. Outside of IDF’s, horizontal cabling, entrance cables, and riser cables must be installed within industry standard pathways, such as cable tray, J hooks, and conduit.

14. Cables shall be permanently identified at each end with an industry approved label.

15. All wall penetrations for telecommunications cabling must be sleeved, with bushings at each end, and firestopped with removable/reusable material which has a minimum 2 hour rating, or in accordance with other architectural details, unless otherwise noted.

15.1. Cables must not be installed through unsleeved holes drilled through walls.

15.2. Comply with Division 07 requirements for Firestopping.

15.3. Comply with TIA 569 on Firestopping.

15.4. Comply with UL1479 or ASTM E814, and label with the UL1479 or ASTM E814 reference number.

27.04.60 TESTING and DOCUMENTATION

1. General

1.1. Acceptance testing shall be completed and documentation provided to the University as soon as possible in order to permit the installation of networking equipment necessary to bring the building online for security and equipment monitoring systems.

2. Testing

2.1. Acceptance testing by the University shall not occur until all work in the telecommunication closet area is completed, including but not limited to mounting and installation of fiber OSP and riser cables, backboards, terminating boxes and cabinets, and grounding blocks, and termination of fiber riser cables, copper backbone cables, station wires, or any other work necessary for the completion of the installation.

2.2. The University shall have the right to schedule acceptance testing at its convenience.

2.3. A University representative, at the option of the University, shall be present during testing.

2.4. Such acceptance testing shall in no way reduce the Contractors' obligations regarding restoration, cleanup, or warranty.

2.5. Contractor shall perform tests necessary prior to acceptance testing to ensure that the installed cables will pass acceptance testing performed in conjunction with University representatives.

2.6. Contractor shall be responsible for performing, tracking, and recording the results of tests.

2.7. Contractor shall be responsible for providing equipment and materials necessary for as long a period of time as necessary to complete testing to the satisfaction of the University.
2.8. Test record forms shall be agreed to by the University prior to the commencement of acceptance testing.

3. **Documentation**

3.1. Provide record plant documentation, including jack type (Information outlet), jack location, circuit length, fiber riser cable lengths, and copper backbone cable lengths and any other information deemed to be useful.

3.1.1. Additionally, provide a list of all existing jacks removed during project demolition phase(s).

3.2. The documentation format(s) will be agreed upon between the campus telecommunication coordinator and the contractor.

3.2.1. Provide all documentation in electronic format.

3.2.2. If it is agreed to use proprietary software to provide testing results, the contractor will be required to furnish licensed system software to run it unless the University already has a licensed version of the contractor’s software.

27.04.70 **RECORD DRAWINGS**

1. Provide updated drawings of telecommunications systems in CAD format.

2. As a minimum, the data provided must include the following elements, where applicable:

2.1. **Inside Plant**

2.1.1. Cable routing.

2.1.2. Riser and OSP cable, pair (count), locations, and final cable lengths.

2.1.3. Supporting structures.

2.1.4. Terminal locations and IDs.

2.1.5. Telecommunications Room and terminal details.

2.1.6. Conduit and cable tray routing, elevations installed at and section lengths.

2.1.7. Pull box locations, elevations installed at and sizes.

2.1.8. Information Outlet locations, label ID’s, types, and serving Telecommunications Room

2.1.9. For each change reflected on the Record Drawings, the Change Order Request number shall be shown.

2.2. **Outside Plant** (provide on an accurate and scaled site plan)

2.2.1. Location of underground routes, indicating type (conduit, direct buried, etc.) and quantities.

2.2.2. Location of manholes and handholes.

2.2.3. Deviations from minimum depth requirements.

2.2.4. XYZ coordinates from ‘permanent’ landmarks.

2.2.5. Footages of conduit between maintenance holes.

2.2.6. Crossings of other utilities uncovered, including type and size of utility.

27.04.80 **WARRANTY**

1. The warranty on labor and material installed by the Contractor shall be in effect for Five (5) years from the date of acceptance of the work.

2. Contractor shall repair, adjust, and/or replace, whichever the University determines to be in its best interests, any defective equipment, materials, or workmanship, as well as such parts of the work damaged or destroyed by such defect, during warranty period, at the Contractor's sole cost and expense.
3. In the event that any of the equipment specified, supplied, and/or installed as part of the work should fail to produce capacities or meet design specification as published or warranted by the manufacturer of the equipment involved or as specified in this document, the Contractor shall, in conjunction with the equipment manufacturer, remove and replace such equipment with equipment that will meet requirements without additional cost to the University.

4. In the event that the Contractor does not affect repair within seven (7) days from the date of notification of such defect, the University may secure repair services from other sources and charge the Contractor for such costs without voiding the warranty.

5. Guarantees of material, equipment, and workmanship running in favor of the Contractor shall be transferred and assigned to the University on completion of the work and acceptance of said work by the University.

27.05.00 COMMON WORK RESULTS

27.05.09 RELATED SECTIONS

Section 26.05.00 – Common Work Result for Electrical
Section 26.05.19 – Low-Voltage Electrical Power Conductors and Cables
Section 26.05.26 – Grounding and Bonding for Electrical Systems
Section 26.05.29 – Hangers and Supports for Electrical Systems
Section 26.05.33 – Raceway and Boxes for Electrical Systems
Section 26.05.36 – Cable Trays for Electrical Systems

27.05.26 GROUNDING and BONDING

1. The Building Telecommunication Equipment Room (IDF-1) shall have a Telecomm Main Grounding Bus Bar (TMGB) that is in compliance with J-STD-607, with minimum dimensions of ¼-inch thick and 4 inches wide, length as required to support current needs and future growth.
1.1. The Ground Bus Bar shall be mounted with stand-off insulators that comply with UL 891 for use in switchboards, 600V, made of Lexan or PVC impulse tested at 5000V.
1.2. Mount the Ground Bus Bar with a minimum of 2 inches of clearance behind the bar.
1.3. Provide a solid or stranded copper wire building earth ground bonded to the electric power ground from the Grounding bus bar in the Building Telecommunication Equipment Room (IDF-1).
1.4. Connections to the TMGB shall be made with exothermic welding or two-hole compression lugs with a two-crimp minimum.
1.5. The busbar shall be cleaned and have antioxidant applied before attaching grounding conductors.
1.6. The TMGB shall be bonded to any electrical panelboards that occupy the same room using a minimum #6 AWG copper conductor with a maximum length of 13 feet.
1.7. All ungrounded telecommunications racks and metallic raceways in the same room as the TMGB shall be bonded to the TMGB.
1.8. The TMGB shall be bonded the building ground system ground or building structural steel.
1.9. The TMGB shall be grounded to the Floor Telecommunication Equipment Rooms (IDF-2’s) Telecommunications Grounding Bus bars (TGBs), forming the Telecommunications Bonding Backbone (TBB) with copper ground wire solid or stranded, insulated or uninsulated, according to length, as detailed in J-STD-607, shown below:
<table>
<thead>
<tr>
<th>WIRE LENGTH</th>
<th>WIRE SIZE (AWG)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;4 m / &lt;13 ft</td>
<td>6</td>
</tr>
<tr>
<td>4-6 m / 14-20 ft</td>
<td>4</td>
</tr>
<tr>
<td>6-8 m / 21-26 ft</td>
<td>3</td>
</tr>
<tr>
<td>8-10 m / 27-33 ft</td>
<td>2</td>
</tr>
<tr>
<td>10-13 m / 34-41 ft</td>
<td>1</td>
</tr>
<tr>
<td>13-16 m / 42-52 ft</td>
<td>1/0</td>
</tr>
<tr>
<td>16-20 m / 53-66 ft</td>
<td>2/0</td>
</tr>
<tr>
<td>&gt; 20 m / &gt; 66 ft</td>
<td>3/0</td>
</tr>
</tbody>
</table>

1.10. The TMGB shall be bonded to the Alternating Current Electrical Ground (ACEG) with a copper ground wire of not smaller gauge than that used for the TBB.

2. Each Floor Telecommunication Equipment Room (IDF-2) shall be equipped with a Telecommunications Grounding Bus bar (TGB) that is in compliance with J-STD-607, with minimum dimensions of ¼-inch thick and 2 inches wide, length as required to support current needs and future growth.
2.1. All ground wires shall be continuous and un-spliced between Equipment Room grounding bus bars.
2.2. Locate grounding bus bars to minimize ground wire lengths; location shall be coordinated with University Information Technology Services representative and University electrical engineer.
2.3. The TGB shall be bonded to any electrical panelboards that occupy the same room using a minimum #6 AWG copper conductor with a maximum length of 13 feet.
2.4. All ungrounded telecommunications racks and metallic raceways in the same room as the TMGB shall be bonded to the TGB.

3. In high rise buildings with multiple Telecommunications Rooms per floor, the top floor TGB’s and every 3rd floor TGB’s shall be bonded together with the same size grounding conductor used in the grounding riser system (TBB).

4. Telecommunications cables with metallic sheath members shall be bonded together at splices with a #6 solid or stranded copper ground wire and bonded to the TMGB or TGB.
4.1. Cable sheaths shall be grounded to a tested and proven earth ground within 50 feet of entering any building with an independent #6 solid or stranded copper ground wire or other electrically equivalent method as approved by the University.

5. Test reports shall include the results of ground testing performed according the electrical system ground testing requirements.

6. Telecommunications equipment racks shall have a grounding bus bar connected to the TMGB or TGB.

27.05.28 PATHWAYS

1. Separation from EMI sources:

1.1. Open cables and cables in nonmetallic raceways and unshielded power:
1.1.1. Electrical less than 2 kVa 5 inch minimum
1.1.2. Electrical 2 to 5 kVa 12 inch minimum
1.1.3. Electrical greater than 5 kVa 24 inch minimum

1.2. Cables in grounded metallic raceways and unshielded power:
1.2.1. Electrical less than 2 kVa 2-1/2 inch minimum
1.2.2. Electrical 2 to 5 kVa 6 inch minimum
1.2.3. Electrical greater than 5 kVa 12 inch minimum
1.3. **Cables in grounded metallic raceways and shielded power:**
1.3.1. Electrical less than 2 kVa 1 inch minimum
1.3.2. Electrical 2 to 5 kVa 3 inch minimum
1.3.3. Electrical greater than 5 kVa 6 inch minimum

1.4. **Cables and electrical motors and transformers 5 kVa or larger** 48 inches

1.5. **Cables and fluorescent fixtures** 5 inches

27.05. **29 HANGERS and SUPPORTS**

1. Hanger and supports must be NRTL (Nationally Recognized Testing Laboratories) labeled for support of Category 6A cabling.

2. J-hooks shall be installed where no provisions for cabling runways.

3. J-hooks shall be installed per ANSI/TIA 569 Commercial Building Standards for Telecommunications Pathways and Spaces.

27.05. **33 CONDUITS and BACKBOXES**

1. **Station conduit:** shall be installed from each station outlet box to the cable tray, clamped to the cable tray and terminated with bushing, size per table or as noted on drawings.

<table>
<thead>
<tr>
<th>Trade Size Conduit</th>
<th>“Standard” Workstations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1”</td>
<td>1</td>
</tr>
<tr>
<td>1-1/4”</td>
<td>2</td>
</tr>
</tbody>
</table>

2. Horizontal distribution conduit shall be installed from junction box joining each station conduit box to the floor telecommunications equipment room, size per table or as noted on drawings.

<table>
<thead>
<tr>
<th>Trade Size Conduit</th>
<th>Workstations &amp; (Station Cables)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 ”</td>
<td>1 (2)</td>
</tr>
<tr>
<td>1-1/4 ”</td>
<td>2 (4)</td>
</tr>
<tr>
<td>1-1/2 ”</td>
<td>3 (6)</td>
</tr>
<tr>
<td>2 ”</td>
<td>5 (10)</td>
</tr>
<tr>
<td>2-1/2 ”</td>
<td>9 (18)</td>
</tr>
<tr>
<td>3 ”</td>
<td>13 (26)</td>
</tr>
<tr>
<td>3-1/2 ”</td>
<td>18 (36)</td>
</tr>
<tr>
<td>4 ”</td>
<td>23 (46)</td>
</tr>
</tbody>
</table>

3. Junction boxes shall be sized according to NEC 314.28, NEC 314.54, Article 770, and to accommodate bending radiuses as discussed in NEC 300.34 and related TIA documents.

3.1. In any case, all methods employed for the installation of interior communication cables should not subject the cables to a bend radius less than the following minimums:
3.1.1. Copper riser communication cables, bending radius not smaller than 8 times the cable diameter.
3.1.2. Copper station communication cables:
3.1.2.1. In conduit, bending radius not smaller than three (3) inches, or 8 times the cable diameter, whichever is greater.
3.1.2.2. In furniture, where the cable is not subject to high pulling tensions, bending radius not smaller than 4 times the cable diameter.
3.1.3. Fiber optic cables, during pulling operations, should not exceed a bending radius smaller than 20 times the cable diameter, or as recommended by the cable manufacturer; after pull is complete, the final cable bend radius should not exceed 10 times the cable diameter.

4. Conduits for interior grade telecommunication cables, such as riser rated and horizontal station cables, may be placed in a slab-on-grade, but must never be placed below the slab for any reason. Likewise, horizontal station cables must not be placed in conduit which is exposed to outside weather conditions. Inside building rated cables are not designed to withstand the moisture and condensation which can occur in underground and exterior conduits, which will render the cable(s) unusable in a short period of time. Although such conduits may be placed in the slab as a last result, whenever possible conduits should be placed above slab, but never below.

27.05.36 CABLE TRAYS

1. **Horizontal distribution**: Cable trays are to be installed as low as possible above the finished ceiling.
   1.1. A clearance of 18" shall be maintained above the trays.
   1.2. 90° turns shall be made by two (2) 45° turns.
   1.3. Cable trays shall not be installed using center point mounts.

2. **Telecommunication Rooms (IDFs)**: 12” wide Ladder Type runways are to circle the IDF room at a minimum 7’ height.
   2.1. Cable tray systems shall be installed so that installed cables will transition to the ladder rack runway without damage to or strain on the cables.
   2.2. Ladder rack also shall be installed perpendicular to and secured to the outward end of the equipment rack(s). (See diagrams)
   2.3. Additional ladder rack shall be used where necessary to stabilize equipment racks in the room or as needed to provide reasonable and shortest distance routing of cables.

3. Refer to Division 26.

27.05.39 SURFACE RACEWAYS

1. Cabling must not be subjected to sharp or binding edges.

2. Surface raceways must be large enough to accommodate all intended telecommunications cables as well as allow for 30% growth.

3. Such raceways and pathways shall installed to support horizontal cabling in accordance with the requirements of ANSI/TIA-569-C.

4. Refer to Division 26.

27.05.43 UNDERGROUND DUCTS and RACEWAYS

1. Manholes shall be precast concrete 12x6x7 A-hole or J-hole type with sump hole.
1. Manhole covers and frames shall have 32" diameter clear opening with heavy duty cast iron lids with penta-head bolts and labeled “Communications”.
1.2. Manholes shall have all racking hardware and pulling irons installed.
1.3. Beginning from center of side wall, racking shall be installed 24” OC.
1.4. Manholes shall be fitted with a manufacturer’s recommended iron ladder.

2. Ducts shall be Schedule 40 PVC, 4” ID nominal trade size, unless noted otherwise.

3. Duct Installation
3.1. Ducts shall be installed with a minimum of 30” of cover.
3.2. Ducts shall be installed a minimum of 12” from electrical conduits.
3.3. Ducts shall be installed as much separation from steam lines as is practical.
3.4. Ducts shall be separated and held in place with duct spacers at intervals of no more than 8 feet.
3.5. Corners and bends of duct runs shall be installed with long radius sweeps, encased in concrete.
3.6. Ducts shall be installed with a minimum of 3” of fall per 100’ toward maintenance holes and away from buildings.
3.7. Ducts shall be surrounded by a minimum of 3” on all sides with flowable backfill.
3.8. Ducts shall then be capped with a minimum 3” concrete no less than the width of the backfilled trench.
3.9. Color top of concrete cap by using Orange chalk dust while still wet.
3.10. An orange magnetically detectable warning tape shall be installed above the top of the ductbank, 18” below ground level.
3.11. Where possible, ducts shall be terminated into precast cutout locations.
3.12. Duct shall NOT penetrate manholes in the collars, in the middle of side walls, or at locations blocked by existing cables in the case of existing manholes.
3.13. Duct penetration should NOT extend beyond the manhole walls.
3.14. Duct penetration locations should allow for easy racking of cables around manhole walls.
3.15. Ducts penetrating manholes, precast handholes, and building entrance wall penetrations which do not land in a pull box, must be terminated flush to the wall(s) using bell ends, illustrated below.

3.16. Building entrance ducts which penetrate the floor must extend high enough up for installation of a bushing to protect the cable sheath from the edges of the conduits, but not much higher in order to allow for routing of cables leaving the conduits.
3.16. Duct shall be sealed around their outer edges with hydraulic cement to prevent leakage into manholes.
3.17. Unused ducts shall be plugged at both ends using compression type fittings.
3.19. NOTE: Innerduct is no longer used in outside plant communications ducts on Indiana University campuses.
4. Installed Duct Preparation
4.1. Pull round wood or steel test mandrel of recommended size through each duct from both directions to remove obstructions.
4.2. Pass a wire brush mandrel and/or a rubber duct swab of appropriate size through each duct until all foreign materials and water are removed.
4.3. Ducts shall be provided with Greenlee, Muletape, or equal continuous measuring tape in each duct.
4.4. Install a locate wire in one duct of each conduit run and terminate on collar of manholes for easy access.
4.5. Unused ducts shall be plugged using compression type fittings

5. Handholes shall be 4x4x4 precast concrete with sump hole.
5.1. Ducts shall be Schedule 40 PVC as described above, or ducts suitable for directional boring.

27.05.53 IDENTIFICATION

1. Comply with Section 27.15.43
2. Otherwise, identify system components according to TIA 606-A.
SCHEDULES for COMMUNICATIONS

See 27.05.26    GROUNDING

Grounding Bus Bar       Comply with J-STD-607-B

See 27.05.29    HANGERS

Horizontal Cable Hangers Penduit J-Pro Series (preferred)
Horizontal Cable Hangers Penduit J-Mod series
Horizontal Cable Hangers Erico Caddy CAT J-Hook: Cat32
Horizontal Cable Hangers Erico Caddy CableCat Wide Base Cable Support Clips

See 27.05.33    CONDUITS and BACKBOXES

Refer to following section on Information Outlets, referencing “See 27.15.43”

See 27.05.36    CABLE TRAY

Cable Tray through building Comply with NEMA VE 2 and TIA-569 cable tray (Not in IDF) or cable basket 12” or larger as needed

See 27.05.43    UNDERGROUND DUCTS and RACEWAYS

Manholes 12x6x7 A-hole or J-hole type with sump hole with manufacturer’s racking hardware, pulling irons, and manufacturer’s iron ladder
Manhole Ducts 4” nominal trade size Schedule 40 PVC.
Handholes 4x4x4 precast concrete with sump hole Schedule 40 PVC, or ducts suitable for directional boring
Handhole ducts
Duct fittings (either) Bell type fittings
Duct plugs (either) Compression type fittings


### See 27.11.16  EQUIPMENT RACKS

- 7’x19” Equipment Rack
- Wire Management Horizontal
- Wire Management Intermediate 12”
- Wire Management Hinged Door 12”
- Wire Management End Panel
- Tie bracket

- Equipment Cabinet (for small buildings) (use must be pre-approved)

Panduit CMR19x84
Panduit WMFH2E
Panduit Patchrunner PEV12
Panduit PED12
Panduit PREP

Cooper B-Line VLWM2425PB
Plexiglas door, Black

---

### See 27.11.19  TERMINATIONS

- Copper backbone Termination
- Horizontal Copper Cabling Patch Panel
- Voice Patch Panel
- Patch Panel Jack Modules:
  - For 6e station wire
  - For 6A station wire
- 1U Fiber Cabinet (requires prior UITS approval)
- 2U Fiber Cabinet (requires prior UITS approval)
- 4U Fiber Cabinet, XFM (standard / preferred)
- 12-fiber LC Cassette, 50 um Multimode
- 24-fiber LC Cassette, 50 um Multimode
- 12 fiber Singlemode Riser Cables
- 24 fiber Singlemode Riser Cables
- Adapter, AFL Cassettes in Corning shelf
- Adapter plate, 6 Duplex LC SM couplers
- Adapter plate, 6 Duplex SC SM couplers

- BlockPanduit Pan-Punch 110 Category 5e system
- Panduit CPPLA24WBLY
- Panduit VP24382TV25Y with RJ21 connector
- Panduit CJ688TGYL TX6 PLUS, yellow
- Panduit CJ6X88TGVL TX6 PLUS, Violet, Cat 6A

- AFL FM001038-BE  3-slot rack mount patch panel, black, empty
- AFL FM001029-BE  6-slot rack mount patch panel, black, empty
- AFL FM001090-BE  12-slot rack mount patch panel, black, empty
- AFL FM000273-B, Black LGX118, Standard Grade
- AFL FM000692-B, Black LGX118, Standard Grade
- AFL FM002996-B XFM Optical Cassette, 12-LC/APC, SM, Black, Aligned Keyway Adapter
- AFL FM002058-B XFM Optical Cassette, 24-LC/APC, SM, Black, Aligned Keyway Adapter

- AFL FM001636 adapter plate
- AFL C215993, loaded with Singlemode LC couplers
- AFL C220853, loaded with Singlemode SC couplers
See 27.11.23  CABLE MANAGEMENT and LADDER RACK

Ladder Rack (in IDF)  
Chatsworth 10250-712* (12” or wider, as required)
*associated parts, as required

See 27.13.13  BACKBONE COPPER (Riser)

Category 3 Copper Backbone Cable  
OFS Type CMP, #24 AWG, twisted pair, solid copper
Category 3, suitable for placement in a plenum

Category 3 Copper Backbone Cable  
Belden Corporation equivalent

Category 3 Copper Backbone Cable  
General Cable, Guardian Products, equivalent

Category 3 Copper Backbone Cable  
Mohawk Wire and Cable Corporation equivalent

Category 3 Copper Backbone Cable  
Commscope, General Instrument, equivalent

Riser Cable to Patch Panel Tie Cable  
Type CMP 25-pair amphenol style cable, #24 AWG
twisted pair, solid copper Category 3

See 27.13.23  BACKBONE FIBER

AFL 12 fiber 50 micron Multimode OM4 Riser Cables, MTP/MTP
FTF-FTF-PL-012R-C-0020-PE-METHOD B  
Cable, pulling eye one end only, 20 meters

FTF-FTF-PL-012R-C-0030-PE-METHOD B  
Cable, pulling eye one end only, 30 meters

FTF-FTF-PL-012R-C-0040-PE-METHOD B  
Cable, pulling eye one end only, 40 meters

FTF-FTF-PL-012R-C-0050-PE-METHOD B  
Cable, pulling eye one end only, 50 meters

FTF-FTF-PL-012R-C-0060-PE-METHOD B  
Cable, pulling eye one end only, 60 meters

FTF-FTF-PL-012R-C-0070-PE-METHOD B  
Cable, pulling eye one end only, 70 meters

FTF-FTF-PL-012R-C-0080-PE-METHOD B  
Cable, pulling eye one end only, 80 meters

FTF-FTF-PL-012R-C-0090-PE-METHOD B  
Cable, pulling eye one end only, 90 meters

FTF-FTF-PL-012R-C-0100-PE-METHOD B  
Cable, pulling eye one end only, 100 meters

FTF-FTF-PL-012R-C-0110-PE-METHOD B  
Cable, pulling eye one end only, 110 meters

FTF-FTF-PL-012R-C-0120-PE-METHOD B  
Cable, pulling eye one end only, 120 meters

FTF-FTF-PL-012R-C-0130-PE-METHOD B  
Cable, pulling eye one end only, 130 meters

AFL 12 fiber Singlemode Riser Cables, MTP/MTP (Data Center Only)
ATF-ATF-PL-012R-Q-0020-PE-METHOD B  
Cable, pulling eye one end only, 20 meters

ATF-ATF-PL-012R-Q-0030-PE-METHOD B  
Cable, pulling eye one end only, 30 meters

ATF-ATF-PL-012R-Q-0040-PE-METHOD B  
Cable, pulling eye one end only, 40 meters

ATF-ATF-PL-012R-Q-0050-PE-METHOD B  
Cable, pulling eye one end only, 50 meters

ATF-ATF-PL-012R-Q-0060-PE-METHOD B  
Cable, pulling eye one end only, 60 meters

ATF-ATF-PL-012R-Q-0070-PE-METHOD B  
Cable, pulling eye one end only, 70 meters

ATF-ATF-PL-012R-Q-0080-PE-METHOD B  
Cable, pulling eye one end only, 80 meters

ATF-ATF-PL-012R-Q-0090-PE-METHOD B  
Cable, pulling eye one end only, 90 meters

ATF-ATF-PL-012R-Q-0100-PE-METHOD B  
Cable, pulling eye one end only, 100 meters

ATF-ATF-PL-012R-Q-0110-PE-METHOD B  
Cable, pulling eye one end only, 110 meters
See **27.13.33** **BACKBONE COAX**

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>CATV Coaxial Backbone Cable</td>
<td>CommScope Video Series CATVP RG11, Plenum Rated or Belden or General Cable equivalent</td>
</tr>
<tr>
<td>CATV Coaxial Backbone Cable</td>
<td>CommScope 2287K, RG11, Plenum Rated or Belden or General Cable equivalent</td>
</tr>
<tr>
<td>CATV Amplifier</td>
<td>ACI Communications, Inc. MFTJ1/42PC419-1 with North American cord set</td>
</tr>
<tr>
<td>CATV Coupler</td>
<td>Tru-Spec</td>
</tr>
<tr>
<td>CATV Coupler</td>
<td>TVC</td>
</tr>
<tr>
<td>CATV Coupler</td>
<td>Scientific Atlanta</td>
</tr>
<tr>
<td>Directional Tap, 4 port</td>
<td>Blonder Tongue SRT-4A, 5-1000 Mhz</td>
</tr>
<tr>
<td>Directional Tap, 8 port</td>
<td>Blonder Tongue SRT-8A, 5-1000 Mhz</td>
</tr>
<tr>
<td>3-way Splitter</td>
<td>Blonder Tongue SXRS-3, 5-1000 Mhz</td>
</tr>
</tbody>
</table>

See **27.15.13** **HORIZONTAL COPPER CABLING**

For **Category 6e** jobs:

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horizontal Station Cable, 6e Plenum</td>
<td>Berk-Tek LanMark 2000 #10167309, Yellow</td>
</tr>
<tr>
<td>Horizontal Station Cable, 6e Plenum</td>
<td>Belden 4813 004 1000 Data Twist 4800, Yellow</td>
</tr>
<tr>
<td>Horizontal Station Cable, 6e Plenum</td>
<td>General Cable 7131902 GenSPEED 6000, Yellow</td>
</tr>
<tr>
<td>Horizontal Station Cable, 6e Plenum</td>
<td>Mohawk M57415 GigaLAN station wire, Yellow</td>
</tr>
<tr>
<td>Horizontal Station Cable, 6e Plenum</td>
<td>Superior Essex NextGain Cat6eX station wire, Yellow</td>
</tr>
</tbody>
</table>

For **Category 6A** jobs:

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horizontal Station Cable, 6A Plenum</td>
<td>Superior Essex 10 Gain XP 6A Plenum P/N 6H-272-7A Purple, .275 inches, bend radius 1.20 inches</td>
</tr>
<tr>
<td>Horizontal Station Cable, 6A Plenum</td>
<td>General Genspeed 10MTP6A Plenum P/N 7131855 Purple, .292 inches, bend radius 1.25 inches</td>
</tr>
<tr>
<td>Horizontal Station Cable, 6A Plenum</td>
<td>Mohawk GigaLan10 6A Plenum P/N HT54298 Purple, .295 inches, bend radius 1.25 inches</td>
</tr>
<tr>
<td>Horizontal Station Cable, 6A Plenum</td>
<td>Bertek LANmark-XTP 6A Plenum P/N 11085661 Violet</td>
</tr>
</tbody>
</table>
**See 27.15.33  HORIZONTAL COAXIAL CABLING**

RG-6 Coaxial Cable, Plenum  
CommScope 2227V RG-6 Quad-shield Plenum, or Belden or General Instrument equivalent

**See 27.15.43  INFORMATION OUTLET**

**Standard Information Outlet, Single Gang face**

- 5 Square Electrical Box ..........  RANDL T-55017 5 Square x 2-7/8” Deep  
  Telecommunications Outlet Box  
- Mud Ring (5/8” drywall)  
  RANDL D-51G058 5 Square x One Gang Extension Ring  
- Faceplate  
  Panduit CFPE4IWY Executive Series, 4-port, off-white faceplate

  **Jack module:**
  - Cat 6e  
    Panduit CJ688TGYL Mini-Com TX-6+ module, Yellow  
  - Cat **6A**  
    Panduit CJ6X88TGVL TX6 PLUS, **Violet**

  **Blank module**
  Panduit CMBIW-X Mini-Com blank module insert, off-white

**Standard Information Outlet, Double Gang face**

- Double Gang Electrical Box  
  RANDL T-55017 5 Square x 2-7/8” Deep  
  Telecommunications Outlet Box  
- Mud Ring (5/8” drywall)  
  RANDL L-52G058 5 Square x Double Gang Extension Ring  
- Faceplate  
  Panduit CFPE10IW-2GY Executive Series, 4-port, off-white

  **Jack module:**
  - Cat 6e  
    Panduit CJ688TGYL Mini-Com TX-6+ module, Yellow  
  - Cat **6A**  
    Panduit CJ6X88TGVL TX6 PLUS, **Violet**

  **Blank module**
  Panduit CMBIW-X Mini-Com blank module insert, off-white

**Standard Information Outlet, Double Gang face, with Video**

- 5 Square Electrical Box  
  RANDL T-55017 5 Square x 2-7/8” Deep  
  Telecommunications Outlet Box  
- Mud Ring (5/8” drywall)  
  RANDL L-52G058 5 Square x Double Gang Extension Ring  
- Faceplate  
  Panduit CFPE10IW-2GY Executive Series, 4-port, off-white

  **Jack module:**
  - Cat 6e  
    Panduit CJ688TGYL Mini-Com TX-6+ module, Yellow  
  - Cat **6A**  
    Panduit CJ6X88TGVL TX6 PLUS, **Violet**

  **Blank module**
  Panduit CMBIW-X Mini-Com blank module insert, off-white

  **F-connector**  
  Panduit CMFIW 75-ohm F-connector module, off-white

*See 27.15.33  HORIZONTAL COAXIAL CABLING*
Wall Phone Outlet

Single Gang Electrical Box ……… 5”x5” minimum 2-7/8” deep single gang box
Mud Ring (5/8” drywall) RANDL D-51G058 5 Square x One Gang Extension Ring
Wall Plate …………………….. Panduit KWP6PY stainless steel plate
(with Category 6 Keystone module
(see also below for Security Phone Wall Plate)

Wireless Access Point Outlet (WAP), Single Gang face

5 Square Electrical Box ……… RANDL T-55017 5 Square x 2-7/8” Deep
Telecommunications Outlet Box
Mud Ring (5/8” drywall) RANDL D-51G058 5 Square x One Gang Extension Ring
Faceplate …………………….. Panduit CFPL2IW-LY Executive Series, 2-port,
off-white faceplate

Jack module:
Cat 6e Panduit CJ688TGYL Mini-Com TX-6+ module, Yellow
Cat 6A Panduit CJ6X88TGVL TX6 PLUS, Violet

Biscuit Jack

Interior Wall Security Phone

Wall Phone Plate Hubbell P630S
Wall Phone Set Cortelco Trendline 815047-VOE-21F

Top of mounted set must be below 48” aff, therefore the installed top of the Wall Phone Plate
should not be higher than 45” aff.

27.08.00 COMMISSIONING

27.10.00 STRUCTURED CABLELING

27.11.00 EQUIPMENT ROOM FITTINGS

27.11.03 WALLS

1. All walls shall be covered with 4’ x 8’ x 3/4” plywood, mounted 0’-6” above the finished floor with the 8’-
0” dimension vertical.
1.1 Backboards shall either be painted with two (2) coats of fire retardant paint on all sides, or fire-
retardant treated and painted.
1.2 Backboard paint color shall be a light gray / off-white.
27.11.13 ENTRANCE PROTECTION

1. Entrance cable protection shall be provided by the installer of outside plant cables, typically IU, in accordance with all applicable codes and standards.

27.11.16 CABINETS, RACKS, FRAMES and ENCLOSURES

1. Equipment Racks

1.1. The equipment rack shall be installed in the Telecommunication Equipment Rooms (IDFs) according to layout and communication media requirements.

1.2. Telecommunication Equipment Room (IDF) layouts shall be coordinated with the appropriate University Information Technology Services representative.

1.3. The rack shall be anchored to the floor and braced overhead with ladder racking and grounded to the ground bus bar location in the IDF with a #6 solid or stranded ground wire.

2. Wire management

2.1. Vertical: Open ends of racks shall have 12” vertical wire management with hinged doors.

2.2. Between multiple racks use 12” vertical wire managers and hinged doors.

2.3. Horizontal: On the top and bottom of each rack, install one horizontal wire manager with covers.
1. **Copper** Equipment

1.1. Unshielded Twisted Pair Riser
1.1.1. Amphenol style cables shall be terminated on 110 type blocks with 110A wiring blocks.
1.1.2. Terminal blocks shall be located so as to be easily cross-connected to feeder pair and the voice cable stations and plugged into the analog voice patch panel.

1.2. Horizontal Cabling Patch Panels
1.2.1. Use Panduit modular 6 port face plate angled patch panels filled with yellow TX-6+ modules
1.2.2. Use a Panduit voice patch panel installed in the rack for analog voice with a 50 pin, 25 pair female amphenol connector
1.2.3. All patch panels, termination panels, and cable managers should be installed so that their fronts, and the front of the networking equipment later provided by owner, shall be visible from the telecommunications room open doorway.

2. **Fiber** Equipment

2.1. Use cable clamps, breakout kits, mounting bracket(s) and other miscellaneous hardware as necessary to complete a proper installation.

2.2. Breakout kits will be required to terminate all loose tube 250 micron fibers (outdoor rated cables).
2.2.1. NOT needed for 900 micron fiber.

3. **Coaxial** Equipment

3.1. Amplifiers, couplers, directional taps, splitters, and associated parts shall be mounted on the telecommunication room plywood covered walls as noted on the prints and in following illustration.
27.11.23 CABLE MANAGEMENT and LADDER RACK

1. A 12" ladder rack shall be installed from the top of and perpendicular to the equipment rack(s) to 4' x 8' wall mounted plywood board, as needed to stabilize equipment racks, and according to room layout and field conditions.

27.11.36 EQUIPMENT RACK LAYOUTS
RACK LAYOUT
Dual Rack Configuration

Front View

Dual Rack Configuration
500 ports maximum, initial

Rev. 07/10/14

PatchLink Cable Manager WMHR2E
Fiber Termination Panel AFL FM001990 BE see specs for further info
VP2438TV250Y Pendant Voice Patch Panel

Network Equipment (provided by IU)
HP 5412

closest to wall
Power Supply (by IU)

Ground Bar
PatchLink Cable Manager WMHR2E

PEV12

48 48
96 96
144 144
192 192
240 240
284 284

24 24
72 72
120 120
168 168
216 216
264 264
288 288
27.11.46 EQUIPMENT ROOM LAYOUT

IDF ROOM - RACK LAYOUT

Open Space with minimum 3 feet of clearance

120v 20 amp TVSS duplex receptacle
208v Electrical outlets NEMA L6-20R

Minimum 12" clearance for equipment rack doors (maximum 18" to outside edge of furthest outlet)

Equipment Footprint
Front of Patch panels (facing toward door)

TWO RACKS
500 ports maximum, initial

Minimum interior space: 9' x 10'***
*** See notes above!!!
DESIGN NOTE: Section of ladder rack must be sized according to maximum cables. For example, if each 12" wide section above will be full, then trays from outside the room coming in will need to be a minimum total 36" of tray width.
27.12.00  TRANSMISSION MEDIA

1. General: Provide telecommunication transmission media of manufacturer's standard materials, as indicated by published product information; designed and constructed as recommended by manufacturer, for a complete installation, and for applications indicated. Except as otherwise indicated, provide copper conductors with conductivity of not less than 98% at 20°C (68°F).

2. Cable Labeling: The National Electrical Code (NEC) requirements dictate that telecommunication cables used within a building are classified as to their use and smoke and flame requirements. Underwriters Laboratories (UL) provides certification that a cable meets the NEC requirements.

3. All cables shall be clearly marked with the proper NEC classification as follows:

<table>
<thead>
<tr>
<th>CABLE TYPE</th>
<th>NEC CLASSIFICATION CODES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fiber Optic</td>
<td>OFNP, OFNR</td>
</tr>
<tr>
<td>Copper UTP</td>
<td>CMR &amp; CMP, Category 3</td>
</tr>
<tr>
<td>Coaxial</td>
<td>CL2R &amp; CL2P, CATVR &amp; CATVP</td>
</tr>
</tbody>
</table>

27.13.00  BACKBONE CABLING

27.13.13 COPPER BACKBONE CABLING

1. Terminating blocks mounted to the wall.

2. Copper backbone cables shall be extended to the equipment rack with 25 pair male amphenol style cables, terminated at the wall on 110 blocks on one end, with the amphenol end plugged into the analog voice patch panels.

3. Cable pairs and 25-pair binder groups shall be cut down in standard color code order.

4. UTP riser cable will have cable ID and pair count clearly marked on building equipment room and punch down blocks.
   4.1. Copper backbone cabling will be labeled in both the building telecommunications equipment room and the floor telecommunications equipment rooms.
   4.2. Cable ID’s will be building number + an underscore + an incremental two digit cable number.
   4.2.1. For example, the cable to IDF-2 would be 023_01, while the cable to IDF-3 would be 023_02.
   4.3. Counts shall start from the lowest IDF number and increment with IDF numbers.
   4.3.1. For example, the cable to IDF-2 would count 023_01, 1-50, while the cable to IDF-3 would count 023_02, 51-100.
   4.4. All labeling must be approved by the appropriate IU UITS personnel.
27.13.23 Testing of Copper Backbone Cabling

1. Perform visual inspection to ensure that all cables are terminated on the punch down block in proper color code order.
2. Test all pairs for continuity and tip and ring polarity.
3. Test results shall meet or exceed the appropriate tests requirements as specified in the ANSI/TIA-568 specifications.
4. Bad pairs shall be limited to a maximum of 1% of the total number of pairs, and with a maximum of two (2) bad pairs per binder group.
5. Test results shall be posted to ProjectDox, emailed to the appropriate UITS representative (depending on whether it is AV or telecom test results) in a timely fashion, and stored on a CD and delivered to the University Information Technology Services representative upon request.
6. Test results shall be verified by the designated University personnel as part of the inspection and acceptance procedure.

27.13.23 OPTICAL FIBER BACKBONE CABBING

1. Installation

1.1. Install FO cables and devices in accordance with industry standards and manufactures written instructions.

1.2. Install FO cable without damage to fibers, cladding, or jacket.

1.2.1. Ensure that media manufactures recommended pulling tensions are not exceeded.

1.3. Do not bend cables to smaller radii than minimums recommended by manufacturer.

1.4. Use a pulling means, including fish tape, rope, and basket-weave grips, that will not damage media or raceway. Install FO cable simultaneously where more than one cable is being installed in the same raceway.

1.5. Use pulling lubricant where necessary; compound used must not deteriorate cable materials. Do not use soap.

1.6. NO splices are allowed. Cable runs to be continuous.

1.7. Provide grounding connections for FO cable and other system components as required by specifications and applicable codes and regulations, according to manufacturer’s written instructions.

1.8. Provide termination of cables.
1.8.1. Use AFL fiber optic connectors on singlemode cables.
1.8.2. Use preterminated MTP/MPO connectors on 50 micron multimode cables with pre-connectorized modules with and AFL cabinets.

1.9. Fiber optic cable will have cable ID and strand count clearly marked on the fiber cabinet in the IDF.
27.13.23 Testing of Fiber Cables

1. General

1.1. It will be the contractor's responsibility to provide the test equipment necessary and document the campus telecommunication coordinator the test equipment available for testing and the last date of certification.

1.2. Cables will have SC (OSP) or LC (riser) connectors installed on singlemode cables prior to testing.
1.3. The tests shall be performed on inter-building and riser fiber cables.

1.3. Testing equipment:
1.3.1. Continuity tester
1.3.2. Visible fault detector
1.3.3. Power meter and light source
1.3.4. OTDR (Optical Time Domain Reflectometer)
1.3.5 Appropriate types of fiber jumpers
1.3.6. Equipment for two testers to communicate
1.3.7. Fluke DSP 4000 or equivalent.
1.3.8. Other equipment as approved by designated University personnel and as required to complete the testing to the satisfaction of the University

1.4. Prior to usage, test equipment and components in accordance with manufactures published test procedures.

1.5. All fibers will be tested bi-directionally per TIA-526-7 and TIA-526-14 method A-2.

1.6. Bi-directional attenuation figures in decibel (dB) will be documented.
1.6.1. Before testing, verify with the University Information Technologies representative if raw or referenced readings are preferred.

1.7. All strands shall test good and meet current ANSI/TIA-568 specifications. Dark fibers and excessive attenuation due to breaks, bends, bad splices, defective connectors and bad installation practices will not be accepted and must be corrected.

1.8. Replacement fiber cables shall be subject to tests and criteria as described in this document.

1.9. All fiber cables shall have NO bad fibers. Fiber cables tested to have bad fibers, and determined to be non-repairable by practices acceptable to the University, shall be replaced at no additional cost to the University.

1.10. Any and all measures taken to correct unacceptable test results will be recorded, along with loss measurements taken before and after corrective measures.

1.11. Documentation will include cable ID, from and to points, strand ID, bi-directional attenuation figures in dB, per TIA Method A-2.

1.12. Use of an OTDR may require that a "launch reel" be used to overcome the OTDR's dead zone, if needed for fault location if the bi-directional tests fail.

1.13. Fiber jumpers used with the OTDR, light source and power meter must be of the same size and type of the fiber being tested.
1.14. Fiber jumpers used with the light source and power meters shall be zeroed out by attaching the jumper from the light source via a coupler to the jumper from the power meter.
1.14.1. This reading noted, will become the reference level to obtain a true attenuation reading (some power meters can be zeroed to allow reading the attenuation level direct).
1.14.2. TIA-526-7 and TIA-526-14 Method A-2 should be used to zero OLTS.

2. Loss Budgets

2.1. Average splice loss shall not exceed 0.35 dB attenuation for multi-mode, 0.25 dB attenuation for single mode, measured from both directions.
2.2. No individual splice, multimode or single mode, shall exceed 0.50 dB attenuation, measured from both directions.
2.3. No termination shall exceed 0.40 dB attenuation for multi mode, 0.30 dB attenuation for single mode.
2.4. Acceptable maximum allowable attenuation per spliced and terminated fiber will be determined by the following formula:

\[
\text{MAX} = (S \times MS) + (E \times ME) + (F \times MF)
\]

Where
- \( S \) = number of splices in fiber between end termination points
- \( MS \) = dB maximum average allowable attenuation per splice
- \( E \) = number of endpoint terminations (namely, 2)
- \( ME \) = dB maximum allowable attenuation per endpoint termination
- \( F \) = number of feet of fiber from endpoint termination to endpoint termination
- \( MF \) = maximum allowable fiber attenuation per foot of fiber
- Manufacturer’s specifications (converted from dB/km by formula (dB per km / 3280.8))

3. Riser Fiber Cable Testing

3.1. Test multimode riser fiber at 850 nm and 1300 nm in both directions.
3.2. Test singlemode riser fiber at 1310 nm and 1550 nm in both directions is to be used.
3.3. No multimode riser fiber shall exceed 0.00021336 dB attenuation per foot at 1300 nm, 400 Mhz bandwidth. (0.70 dB attenuation per kilometer at 1300 nm, 400 Mhz bandwidth).

4. Entrance / Outside Plant Fiber Cable Testing

4.1. Test entrance fiber with an OLTS per TIA-526-7 method A-2, Option 1.
4.1.1. Test with an optical time domain reflectometer (OTDR) if needed per Option 2.
4.1.2. ORL should be -30 dB or higher.
4.2. Test singlemode entrance fiber at 1310 nm and 1550.
4.3. Test cable segments for faulty connectors and terminations, and for the integrity of the cable and its component parts.
4.4. Replace malfunctioning of damaged items with new materials, then retest until satisfactory performance is achieved. Test cable in both directions using the wavelengths described above.
### 27.13.33 COAXIAL BACKBONE CABLEING

1. **Design Specifications** for Campus Cable Distribution System

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<td>+40 dbmV at visual carrier, aural carrier shall be – 10 to -17 - 6 dbmV in respect to visual carrier</td>
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<td>Signal leakage</td>
<td>Maximum signal leakage from the system shall not exceed -40 dbmV at CATV channel 'A' (121.25 MHz), and shall not exceed -53 dbmV at CATV channel 'W' (295.25 MHz)</td>
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<td>Spurious output</td>
<td>Spurious output of modulators/processors shall not exceed -70 dbmV</td>
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<td>Shall exceed -54 dbmV at last tap</td>
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<td>System shall perform as specified at temperatures 120°F between 32°F</td>
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<td>System hum and noise shall exceed -50 dbmV at all points</td>
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<td>Adjacent carriers</td>
<td>Adjacent channel carriers shall be within 2 dbmV</td>
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<tr>
<td>Receive outlet level</td>
<td>+6 dbmV, +4 dbmV -3 dbmV</td>
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<tr>
<td>Return outlet level</td>
<td>+10 dbmV, +15 dbmV -0 dbmV at the &quot;head-end&quot; equipment with signal injected by modulator (+60 dbmV, +0 dbmV -45 dbmV adjustable) located in technology equipment</td>
</tr>
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</table>

2. **Labeling** of all coaxial cables will have the building equipment room and floor equipment room ends clearly marked with the cable ID number.

3. **Testing of coaxial cables**

3.1. Cables will have connectors installed on ends prior to testing.
3.2. Cable must be 100% sweep tested and CERTIFIED to meet with CATV standards.
3.3. Frequency response from 50 MHz to 1 GHz will be measured and shall indicate no greater than 7 dbmV system tilt.
3.4. Attenuation will be measured end to end using 150 MHz as a test signal and attenuation will be documented in dbmV.
3.5. Documentation will include cable ID, from and to points, frequency response, attenuation figures and as built information.
27.15.00  HORIZONTAL CABBING

27.15.13 COPPER HORIZONTAL CABBING

1. Before the installation of Horizontal Cabling will be allowed to begin, the telecommunications subcontractor must provide a mock-up of the labeling and wiring to a sample face-plate and patch panel.
   1.1. The mock-ups must be reviewed by an appropriate representative of UITS and approved prior to performing any final wiring required by the project documents.

2. Installation of Horizontal Copper Cabling

2.1. 4-pair UTP cables should withstand 25 foot-pounds of pulling pressure. This number shall be verified by the wire manufacturer.
   2.1.1. Maximum cable length is limited to 90 meters (295 feet) from the jack to the patch panels.
   2.1.2. Comply with ANSI/TIA-569 standard regarding the requirements and recommendations for separation of copper telecommunication cabling from sources of electromagnetic interference.
   2.1.3. The Contractor shall replace any damaged cable at no expense to the University. No repair will be allowed on damaged cables.

2.2. Cabling shall be terminated at the station jack and at the equipment room as indicated in ANSI/TIA-568, wiring configuration T568A.
   2.2.1. The modular faceplate at the user end shall be equipped with inserts for communication services as indicated on plans.
   2.2.2. Station cable in the IDF shall be terminated on Category 6e or Category 6A (as appropriate) patch panels located in the equipment racks.
   2.2.3. The minimum bend radius of Category 6e/A UTP cable shall not be smaller the manufacturer’s recommended minimum at any time during installation or after completion, and shall not cause the cable jacket to buckle.
   2.2.4. Route cables from the back of the patch panel through its coupler openings and loosely attach them to the wire manager with velcro cable ties, leaving enough slack for re-termination at a future date.
   2.2.5. Remove only as much jacketing as needed to terminate properly to the connecting hardware, keeping the amount of jacketing removed to an absolute minimum.
   2.2.6. Do not untwist pairs more than 0.5 inches.
   2.2.7. Visually inspect cable pairs for bare wire and other defects before terminating wires.
   2.2.8. Once all of the cables have been terminated, dress the cable slack behind the panel with velcro tie wraps tightened to a snug but not compressing fit.

2.3. Telecommunication cabling for elevator emergency phones shall be provided as follows:
   2.3.1. Cabling for the elevator telephone to the elevator control room is by the elevator installer.
   2.3.2. Cabling from the elevator control room to the telecommunication equipment room is by the electrical contractor.
   2.3.2.1. Jack must be mounted adjacent to, but outside of the elevator electrical panel.
   2.3.3. The electrical contractor shall notify campus personnel of the elevator service date.
   2.3.3.1. This notification for request of services shall be provided no fewer than 21 days prior to service.

3. Testing of Horizontal Copper Cabling

3.1. Perform visual inspection to ensure that all cables are terminated on the eight position station jacks on both ends in proper color code order.
   3.2. All station cables attached between information outlets and floor equipment room patch panels will be link tested with a cable analyzer to ensure compliance with current ANSI/TIA-568.
   3.3. All pairs shall test good and meet Category 6e or 6A parameters for the respective type of cable.
3.3.1. Open, split, miss-terminated pairs, deviations from the manufacturer's installation specifications, defective connections and bad installation practices will not be accepted and must be corrected.

3.4. Test 100% of station wire in both directions with a certified handheld tester appropriate for the type of station wire installed (6e or 6A), such as the Fluke OmniScanner or the Fluke DSP 4000 and other test equipment as necessary to assure proper termination sequences, continuity, and Category 6e/A compliance. Station wire shall have NO bad pairs.

3.5. When all station wire is determined to be acceptable, University Information Technology Services will spot test the plant using a certified handheld tester, such as the Fluke OmniScanner or Fluke DSP 4000.

3.6. Test results shall meet or exceed the appropriate tests requirements as specified in the ANSI/TIA-568 specifications.

3.7. The approved handheld tester will have the capability to be programmed with current Category 6e/A requirements as specified in ANSI/TIA-568 standards.

3.8. Documentation will include cable ID (same as jack ID) to be marked on the punch down blocks and patch panels in the telecommunication closet, station jack ID to be marked on the station jack and results of the testing done with the cable analyzer.

3.9. Analyzer documentation test result must be provided in the native format such as *.flw (not PDF) of the testing equipment used.

3.9.1. Results must be labeled using the information outlet labeling scheme for the project.

3.10. Test results shall be stored on a CD and delivered to the University Information Technology Services representative, or transmitted electronically to both the appropriate UITS representative and to the appropriate University Architect’s Office representative.

3.11. Test results shall be verified by the designated University personnel as part of the inspection and acceptance procedure.

4. Submission of test results

4.1. In order to facilitate quicker turn-around for ordering and activating new information outlets in the building, the Telecommunications Subcontractor shall submit partial jack lists that are tested and approved rather than submitting the lists and test results of the entire building.

4.1.1. The details of how the partial lists are created will be determined in the field through coordination between the Telecommunications Subcontractor and the UITS Technical Staff.

4.1.2. As an example, test results could be submitted by IDF as work in an IDF is completed.

4.1.3. Special care must be taken to assure that telecommunications outlets for Fire Alarm systems and Elevator, which will be required for state inspections, be installed, tested and verified with sufficient lead times to meet the project construction and occupancy schedule.

27.15.23 OPTICAL FIBER HORIZONTAL CABLEING

Not Applicable

27.15.33 COAXIAL HORIZONTAL CABLEING

1. All coaxial cables will have the building equipment room and floor equipment room ends clearly marked with the cable ID number.

2. Testing of coaxial horizontal cables

2.1. Cables will have connectors installed on ends prior to testing.

2.2. Cable must be 100% sweep tested and CERTIFIED to meet with CATV standards.

2.3. Frequency response from 50 MHz to 1 GHz will be measured and shall indicate no greater than 7 dbmv system tilt.
2.4. Attenuation will be measured end to end using 150 MHz as a test signal and attenuation will be documented in dbmv.

2.5. Documentation will include cable ID, from and to points, frequency response, attenuation figures and as built information.

27.15.43 FACEPLATES AND CONNECTORS

1. Termination equipment

1.1. All station cables in the IDF shall be terminated on rack mounted patch panels.

2. Information Outlet Rough-In

2.1. Standard Information Outlets (single gang or double gang) shall be located at the same height as 120 volt AC outlets (normally 18" above finished floor).

2.2. Wall mounted telephones require a double gang box with a single gang plaster ring, positioned 40" A.F.F. to the center of the outlet box.

2.3. Information Outlets above counter tops should be installed so that the center of the outlet box will be a minimum of 12" above the counter top.

2.3.1. A counter top with a splash back may require different outlet box locations.

2.4. Wall mounted telephones require a special wall telephone jack that provides mounting lugs for the telephone and an eight position jack.

2.5. No Information Outlet will be installed such that workstations or devices served from it cannot be reasonably reached by a 16 ft cord.

3. Labeling of Horizontal Copper Cabling

3.1. The telecommunications contractor’s onsite representative(s) shall schedule a meeting with the UITS representative through the IU Project Manager prior to the permanent labeling of Information Outlets and IDF patch panels.

3.2. Information Outlet receptacles, cables, and terminations shall be labeled with a standard identification tag at both the Information Outlet and on the jackfields in the IDF/Wire Closet.

3.2.1. Tags shall be preprinted or computer printed with indelible water proof ink and mechanically secured in a permanent fashion; for example, such as using an appropriate label maker with 3/8" tape.

3.2.2. Handwritten labels are NOT acceptable.

3.1.3. Labels shall be mounted in a manner which permits easy access and viewing.

3.1.4. The station cable serving each receptacle must be labeled at the room receptacle and the IDF rack.

3.3. Information Outlet receptacles in rooms are to be labeled -A through -ZZ in each room beginning with the first receptacle to the left of the main entrance to the room and continuing clockwise around the room.

3.3.1. All labeling will be done in all capital letters.

3.3.2. For example, a jack labeled 246A-A would be because:

3.3.2.1. Room 246A is the room number

3.3.2.2. The Information Outlet designation is “A” (first receptacle in room from the left of the door)
3.3.2.3. Station cables from a given room shall be terminated in sequential order, i.e. – 246A-A, 246A-B, 246A-C, 246A-D, etc. If double letters are needed, the progression would be –AA, -AB, AC, … -AZ, -BA, -BB, etc.

3.4. Information Outlets for special purposes shall have a unique identifier listed with the jack ID.
3.4.1. The identifier shall be inserted into the Outlet ID, between the room number and the Outlet designator as indicated in following drawings.
3.4.2. Identifiers are listed below:

3.4.2.1. Building Automation "100+BA-A"
3.4.2.2. Fire Panel "100+FP-A"
3.4.2.3. Wireless Access Point (WAP) "100+WD-A" (Wireless Data)

3.5. ALL LABELING SHALL BE COORDINATED WITH AND APPROVED BY AN APPROPRIATE UITS REPRESENTATIVE.
3.5.1. Schedule a meeting with the UITS representative through the IU Project Manager prior to the permanent labeling of Information Outlets and IDF patch panels.
ALL DATA CONFIGURATION

JACK LABELING

Room 101A

2 ports
4 ports
4 ports
5 ports

Standard Information Outlet
(above)

Wire Closet / IDF Station Patch Panels
Labeling Example

Note: Pins on top

Xn = Jackfield Port
(not labeled on Room Outlet,
is labeled on Jackfield)
JACK LABELING

SPECIAL JACKS
(INFORMATION OUTLETS)

Room 100

Building Automation "100+BA-A"
Fire Panel "100+FP-A"
Wireless access point (WAP) "100+WD-A"

Note: Pins on top

1 port

1 port

Information Outlet (above)

Wire Closet / IDF Station Patch Panels Labeling Example

Xn = Jackfield Port (not labeled on Room Outlet, is labeled on Jackfield)
27.20.00 DATA COMMUNICATIONS

User End Equipment and IDF Network Equipment provided by IU

27.30.00 VOICE COMMUNICATIONS

User End Equipment provided by IU

27.40.00 AUDIO-VIDEO COMMUNICATIONS

User End Equipment and A/V Closet Equipment provided by IU

27.50.00 DISTRIBUTED COMMUNICATIONS and MONITORING SYSTEMS

27.60.00 WIRELESS TRANSCEIVERS

Equipment provided by IU